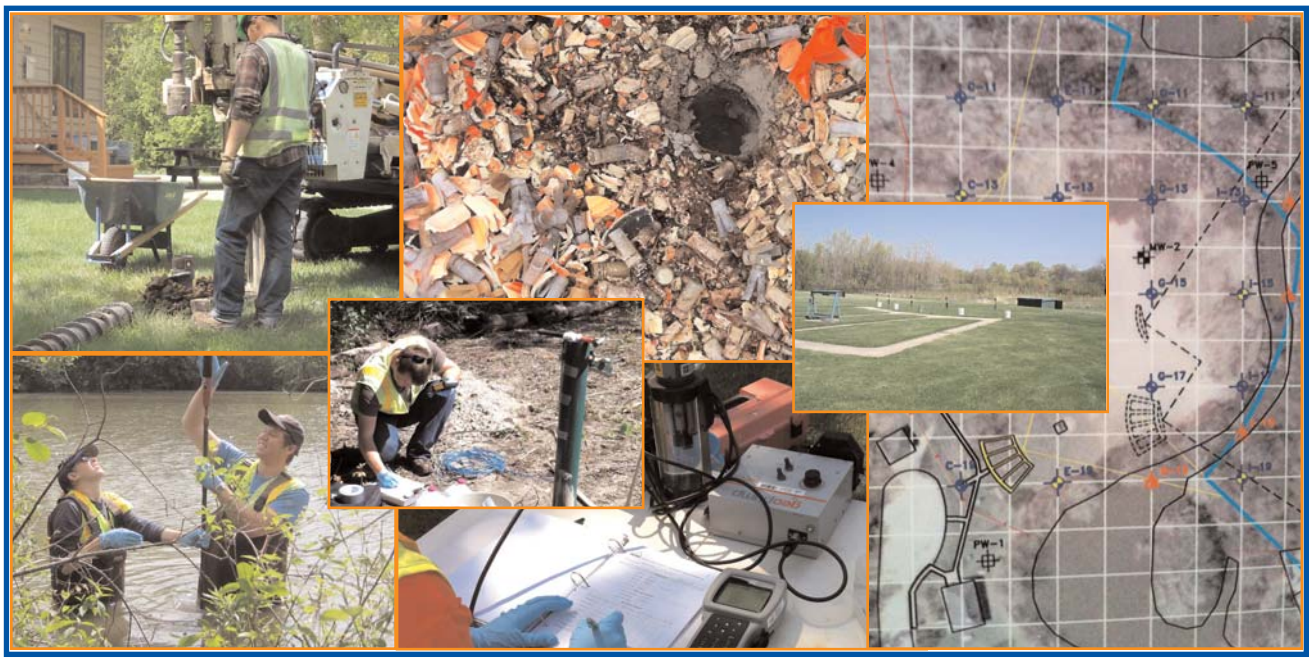
ILLINOIS SITE REMEDIATION PROGRAM SUBMITTAL

FOCUSED SITE INVESTIGATION REPORT

NAPERVILLE SPORTSMANS PARK
735 SOUTH WEST STREET
NAPERVILLE, ILLINOIS

IEPA LPC# 0434670024 / DuPage County



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ACRONYMS AND ABBREVIATIONS

ASTM	American Society for Testing and Materials
bgs	below ground surface
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
COC	Contaminant of Concern
DRM	Division of Remediation Management
ESA	Environmental Site Assessment
FOC	Fractional Organic Carbon
GPS	Global Positioning System
GRO	Groundwater Remediation Objective
IAC	Illinois Administrative Code
Illinois EPA	Illinois Environmental Protection Agency
IL ELAP/NELAP	Illinois Environmental Laboratory Accreditation Program/National Environmental Laboratory Accreditation Program
ISGS	Illinois State Geological Survey
ISWS	Illinois State Water Survey
kg	kilogram
mg	Milligram
mL	Milliliter
MSL	Mean Sea Level
NOAA	National Oceanic and Atmospheric Administration
NAD	North American Datum
NFR	No Further Remediation
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
OSHA	Occupational Safety and Health Administration
PID	Photo-ionization Detector
PIN	Parcel Identification Number
PNA	Poly-nuclear Aromatic Hydrocarbons
PRC	Probable Effect Concentration
QA/QC	Quality Assurance/Quality Control
RAP	Remedial Action Plan
RCRA	Resource Conservation and Recovery Act
ROR	Remedial Objectives Report
Shaw	Shaw Environmental, Inc.
SIWP	Site Investigation Work Plan
SCS	Soil Conservation Service
SOP	Standard Operating Procedure
SQG	Sediment Quality Guideline
SRC	Sediment Remediation Concentration
SRO	Soil Remediation Objective
SRP	Site Remediation Program
STATGO	State Soil Geographic Database
SVOC	Semi-volatile Organic Compound
SWAPP	Source Water Assessment Protection Program
TACO	Tiered Approach to Corrective Action Objectives
TCLP	Toxicity Characteristic Leaching Procedure
TC	Toxicity Characteristic
TEC	Threshold Effect Concentration
TPH	Total Petroleum Hydrocarbons
USACE	United States Army Corps of Engineers

USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VOC	Volatile Organic Compound
XRF	X-Ray Fluorescence

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735 SOUTH WEST STREET, NAPERVILLE, ILLINOIS
ILLINOIS SITE REMEDIATION PROGRAM SUBMITTAL

EXECUTIVE SUMMARY

Shaw Environmental, Inc. (Shaw) has prepared this *Focused Site Investigation Report (FSIR)*, for the Naperville Sportsman's Park located at 735 South West Street in Naperville, DuPage County, Illinois (hereinafter referred to as the Site). The *FSIR* was completed on behalf of the Remedial Applicant, the Naperville Park District (NPD).

The 27-acre Site is managed by the NPD and owned by the City of Naperville. The NPD leased the property in 1988 for a 99-year term. Since 1948, Sportsman's Park utilization has included gun club activities, which are conducted by the Naperville Sportsman's Club. The Site was previously enrolled in the Illinois Environmental Protection Agency (IEPA) Site Remediation Program (SRP). The portion of the Site located outside of the Shooting Range fence was issued a *no further remediation* determination of Total Lead in 1998.

Prior to assessment activities, a Phase I Environmental Site Assessment (ESA) and Site Investigation Work Plan (SIWP) were submitted to SRP for review and approval. The SIWP was revised in accordance with SRP comment, resubmitted (IEPA Log No. 12-49751) and approved by the SRP in a January 30, 2012 correspondence. In general, this investigation was completed in accordance with the IEPA approved SIWP and the requirements of 35 Illinois Administrative Code (IAC) Part 740.430 and Parts 740.435.

The objective of the focused investigation was to characterize and identify the nature and extent of Site environmental impacts resulting from the former/historical trap-shooting and small arms shooting range activities. Prior to 1998, practices at the Site included the use of lead bearing shot and bullets and Poly-Nuclear Aromatic (PNA) bearing bituminous clay pigeon/targets. At this time, the Site National Pollutant Discharge Elimination System (NPDES) permit (IL0073253) requires the use of environmentally friendly steel shot and biodegradable targets.

The Site is covered with a mix of densely wooded areas, wetlands, surface water features and improved with various structures including a "club house" building, detached storage garage, and typical trap shooting range amenities. The land use surrounding the property is best described as mixed commercial and residential use. The Site property is leased by the NPD from the City of Naperville.

Based on information obtained during the Shaw 2012 focused investigations, including the results of field observations and analysis of numerous soil, sediment, groundwater and surface water samples, Shaw has developed the following conclusions:

1) The investigation consisted of making a total of 7 soil borings throughout the investigation area. The borings were continuously sampled to depths ranging between 12 and 16 feet below ground surface (bgs). With few exceptions, the sample recoveries were typically good, and the subsurface stratigraphy encountered was generally consistent at each of the boring locations. The subsurface stratigraphy predominantly consisted of of fine grained materials (clays and silts) with intermingled sands and gravels. Gray silty clay was encountered at approximately 16 feet bgs to the terminus of the borings. Based on measurements obtained from 9 monitoring wells installed at the Site and one off site

monitoring well, groundwater levels within the investigation area ranged from approximately 1.51 to 20.25 feet bgs. Multiple measurements made during this investigation indicated that groundwater flow direction varies. The minimum and maximum measured gradient is 0.001 to 0.007 ft/ft, respectively. The results of in-situ permeability tests performed in the monitoring wells indicated that the average hydraulic conductivity of the water bearing unit is 4.55×10^{-5} cm/sec.

In order to characterize the shot fall deposition zone and berms, the investigation also included: 130 hand auger borings to a depth of 18 inches bgs, 12 surface water samples, and 20 core samples advanced into sediments.

2) A total of 303 soil samples were systematically obtained from throughout the investigation area for laboratory and/or XRF analysis. Two hundred and one soil samples were submitted to an environmental laboratory for chemical analysis of the focused contaminants of concern: Total Metals (Lead, Arsenic, Barium, Cadmium, Chromium, Mercury, Selenium, Silver, Antimony, Copper, and Zinc), and PNAs. Select soil samples were also tested for pH, Fractional Organic Carbon (FOC) and Toxicity Characteristic Leaching Procedure (TCLP) Metals.

   Consistent with previous investigation conducted at the Site (as summarized in IEPA June 1997 Project Summary), results of the chemical analyses identified various contaminants of concern in several of the soil samples at concentrations that exceed their most stringent *Tiered Approach to Corrective Action Objectives* (*TACO*) Tier 1 Soil Remedial Objectives (SROs). Contaminants of concern include: Lead, Arsenic, Antimony and select PNA compounds. Furthermore, 27 samples exceeded the RCRA Toxicity Characteristic (TC) threshold concentration of 5.0 mg/L for Lead.

3) A total of 9 groundwater samples were obtained from 9 monitoring wells installed at the Site. The groundwater samples were submitted to an environmental laboratory for chemical analysis of Total Metals (Lead, Arsenic, Barium, Cadmium, Chromium, Mercury, Selenium, Silver, Antimony, Copper, and Zinc), and PNAs. Benzo(a)anthracene exceeded the *TACO* Tier 1 Groundwater Remedial Objective (GRO) for the Class I Groundwater Ingestion Exposure Pathway at 1 monitoring well location.

4) A total of 48 sediment samples were obtained at the Site. The sediment samples were submitted to an environmental laboratory for chemical analysis of Total Metals (Lead, Arsenic, Barium, Cadmium, Chromium, Mercury, Selenium, Silver, Antimony, Copper, and Zinc), and PNAs. Select soil samples were also tested for pH, Fractional Organic Carbon (FOC) and Toxicity Characteristic Leaching Procedure (TCLP) Metals. Select PNAs and Inorganic Metals exceeded the IEPA and US EPA guidance criteria. Additionally, 9 samples exceeded the RCRA Toxicity Characteristic (TC) threshold concentration of 5.0 mg/L for Lead.

5) A total of 12 surface water samples were obtained at the Site over 2 separate sampling events. Six (6) initial surface water samples were submitted to an environmental laboratory for chemical analysis of one or more of the following Total Metals (Lead, Arsenic, Barium, Cadmium, Chromium, Mercury, Selenium, Silver, Antimony, Copper, and Zinc), and PNAs. Based upon the initial water sample results, 1 sample detected Total Lead. Six (6) additional water samples were subsequently collected and tested for Dissolved Lead and Total Hardness, for direct evaluation of the Lead water quality standard. None of the supplemental water samples exceeded the surface water quality standard for Dissolved Lead.

6) Shaw recommends that a *Remedial Objectives Report/Remedial Action Plan* be developed and submitted to the Illinois Environmental Protection Agency Site Remediation Program for review and approval.

1.0 INTRODUCTION

Shaw Environmental, Inc. (Shaw) has prepared this *Focused Site Investigation Report (FSIR)*, for the property commonly referred to as the Naperville Sportsman's Park, located at 735 South West Street in Naperville, Du Page County, Illinois (hereinafter referred to as the Site). The *FSIR* was completed on behalf of the Naperville Park District (NPD), the *Remedial Applicant*.

The Site is comprised of approximately 27 acres of land and is currently improved as a public trap-shooting range operated by the NPD, with assistance from the *Naperville Sportsman's Club*. In 2000, the trap- shooting operations were restricted to the use of steel-shot and bio-degradable clay pigeon/target materials only. The Site is covered with a mix of densely wooded areas, wetlands, surface water features and improved with various structures including a "club house" building, detached storage garage, and typical trap-shooting range amenities. The land use surrounding the property is best described as mixed commercial and residential use. The Site property is leased by the NPD from the City of Naperville.

Figure 1 identifies the location of the Site and surrounding area on a United States Geological Survey (USGS) topographic quadrangle map.

1.1 Previous Environmental Investigations and Documentation

Previous Site investigations have been completed at the Site by several different consultants. In preparation of this *FSIR*, Shaw reviewed and relied upon information and data provided in the following documents:

- *Sample Visit Report for Sportsman's Club, Naperville, Illinois* (Susan Lorenz, Environmental Chemist, November 1989);
- *Analytical Report* (National Environmental Testing, Inc., March 1993);
- *Naperville Park District, Lead in Soil Collection and Analysis Project* (Micro-Fiber Laboratories, Inc., October 1993);
- *Environmental Study of the Naperville Sportsman's Club* (Packer Engineering, Inc., December 1994);
- *Environmental Study of the Naperville Sportsman's Club* (Packer Engineering, Inc., August 1995);
- *Addendum to Report of August 11, 1995, Environmental Study of the Naperville Sportsman Club* (Packer Engineering, Inc., June 1996);
- *Monitoring Well Installation Report* (Testing Service Corporation, December 1996);
- *Sportsman's Park, Naperville, Illinois* (Testing Service Corporation, April 1997);
- *Naperville Sportsman's Club, Soil and Groundwater Analysis of Naperville Sportsman's Club and Adjacent Properties* (Packer Engineering, Inc., May 1997);
- *Project Summary for Naperville Sportsman's Park, Naperville, Illinois* (Illinois Environmental Protection Agency, June 1997);
- *Sportsman's Park, Naperville, Illinois (E. Cooney Associates, Inc., March 2008);*
- *Lead Project Report, Lead Survey, Naperville Sportsman Club, 735 S. West Street, Naperville, Illinois* (JMS Environmental Associates, Ltd., June 2008);
- *Discharge Monitoring Reports* (Naperville Park District 2001-2011);
- *Water Sample Results Sportsman's Park Pond* (E. Cooney Associates, Inc., May 2010);

- *Non-Potable Water Supply Sampling, Sportsman's Park Clubhouse, 735 S. West Street, Naperville, Illinois* (Shaw Environmental, Inc, June 2010).
- *Lead Professional and Analytical Services, Background Lead Surface Wipe Testing & Analysis, The Sportsman's Park Community Center, 735 S. West Street, Naperville, Illinois* (United Analytical Services, Inc., March 2011 and May 2011);
- *Phase I Environmental Site Assessment for Sportsman's Park, Naperville, Illinois (Shaw Environmental, June 2011).*
- *Routine Wetland Assessment Report for Sportsman's Park, Naperville, Illinois (Shaw Environmental, August 10, 2011)*
- *Revised Site Investigation Work Plan for Sportsman's Park, Naperville, Illinois (Shaw Environmental, January 2012).*

Pertinent information and applicable data obtained from the above referenced reports and documents have been included within the text and appendices of this *FSIR*.

1.2 Investigation Objectives

The objective of the *Focused Site Investigation (FSI)* was to complete a Site characterization, including an assessment of the nature and extent of potential environmental contaminant impacts to Site soils, sediments, groundwater and surface water resources resulting from of the historical Site use as a trap-shooting range and small arms shooting range facility. The goal of the *FSI* was to successfully complete the environmental assessment in accordance with the IEPA/SRP approved *Revised Site Investigation Work Plan (Revised SIWP)* and associated *Response to IEPA Comments*, dated January 10, 2012.

An IEPA/SRP *DRM-2 Form* has been attached to this *FSIR* certifying completion of this report in accordance with the Illinois Environmental Protection Act (415 ILCS 5), 35 Illinois Administrative Code, Part 740 requirements, and generally accepted professional engineering and geology principles.

2.0 SITE CHARACTERIZATION

2.1 Site Location

The Site is located at 735 South West Street, in Naperville, DuPage County, Illinois. **Figure 1** identifies the location of the Site on a USGS topographic quadrangle map.

The Site is identified under the following Tax Parcel Identification Number (PIN): 07-24-106-007 (northern side of property), and 07-24-302-010 (southern side of property) and is located in the northwest ¼ of the northeast ¼ of Section 24, Township 38 North, Range 9 East of the Third Principal Meridian in Naperville, DuPage County, Illinois.

A complete legal description for the Site is provided as follows:

> THAT PART OF THE WEST HALF OF SECTION 24, TOWNSHIP 38 NORTH, RANGE 9 EAST OF THE THIRD PRINCIPAL MERIDIAN, DESCRIBED BY COMMENCING AT THE NORTHWEST CORNER OF THE NORTHEAST QUARTER OF SAID SECTION 24; THENCE EAST 151.8 FEET ALONG THE NORTH LINE OF SAID NORTHEAST QUARTER; THENCE SOUTH 12 DEGREES, 38 MINUTES EAST 480.0 FEET TO THE CENTER OF THE NAPERVILLE AND AURORA ROAD; THENCE SOUTH 69 DEGREES, 20 MINUTES WEST 861.3 FEET ALONG THE CENTER OF SAID ROAD AND THE CENTER OF THE OSWEGO

ROAD; THENCE SOUTH 1 DEGREE 28 MINUTES EAST 576.1 FEET; THENCE NORTH 66 DEGREES, 58 MINUTES EAST 35.0 FEET; THENCE SOUTH 35 DEGREES, 22 MINUTES EAST 478.6 FEET; THENCE SOUTH 68 DEGREES, 20 MINUTES WEST 101.3 FEET FOR A PLACE OF BEGINNING; THENCE SOUTH 21 DEGREES, 11 MINUTES WEST 794.1 FEET; THENCE SOUTH 19 DEGREES, 35 MINUTES EAST 566.3 FEET; THENCE SOUTH 61 DEGREES, 57 MINUTES WEST 891.0 FEET; THENCE NORTH 2 DEGREES, 22 MINUTES WEST 1321.65 FEET; THENCE NORTH 68 DEGREES, 20 MINUTES EAST 1009.3 FEET TO THE PLACE OF BEGINNING, CONTAINING 22.11 ACRES, TOGETHER WITH RIGHT OF INGRESS AND EGRESS TO AND FROM THE LEASED PREMISES OVER A STRIP OF LAND OF A UNIFORM WIDTH OF TWENTY-FIVE FEET, THE WESTERLY LINE OF WHICH IS DESCRIBED AS FOLLOWS:

COMMENCING AT THE NORTHWEST CORNER IF THE NORTHEAST QUARTER OF SECTION 24, TOWNSHIP 38, NORTH RANGE 9, EAST OF THE THIRD PRINCIPLE MERIDIAN; THENCE EAST 151.8 FEET ALONG THE NORTH LINE OF SAID NORTHEAST QUARTER; THENCE SOUTH 12 DEGREES, 38 MINUTES EAST 480.0 FEET TO THE CENTER OF THE AURORA AND NAPERVILLE ROAD; THENCE SOUTH 69 DEGREES, 20 MINUTES WEST 861.3 FEET ALONG THE CENTER OF SAID ROAD AND THE CENTER OF THE OSWEGO ROAD FOR A PLACE OF BEGINNING; THENCE SOUTH 1 DEGREES, 28 MINUTES EAST 512.84 FEET; THENCE SOUTH 35 DEGREES, 22 MINUTES EAST 538.65 FEET; THENCE SOUTH 68 DEGREES, 20 MINUTES WEST 101.3 FEET, SITUATED IN THE TOWNSHIP OF NAPERVILLE, COUNTY OF DUPAGE AND STATE OF ILLINOIS.

AND

THAT PART OF THE WEST HALF OF SECTION 24, TOWNSHIP 38 NORTH, RANGE 9 EAST OF THE THIRD PRINCIPAL MERIDIAN, DESCRIBED BY COMMENCING AT THE NORTHWEST CORNER OF THE NORTHEAST QUARTER OF SAID SECTION 24; THENCE EAST 151.8 FEET ALONG THE NORTH LINE OF SAID NORTHEAST QUARTER; THENCE SOUTH 12 DEGREES, 38 MINUTES EAST 480.0 FEET TO THE CENTER OF THE NAPERVILLE AND AURORA ROAD; THENCE SOUTH 69 DEGREES, 20 MINUTES WEST 861.3 FEET ALONG THE CENTER OF SAID ROAD AND THE CENTER OF OSWEGO ROAD; THENCE SOUTH 1 DEGREE, 28 MINUTES EAST 576.1 FEET; THENCE NORTH 66 DEGREES, 58 MINUTES EAST 35.0 FEET; THENCE SOUTH 35 DEGREES, 22 MINUTES EAST 476.8 FEET; THENCE SOUTH 68 DEGREES, 20 MINUTES WEST 80.0 FEET FOR A PLACE OF BEGINNING; THENCE SOUTH 2 DEGREES, 2 MINUTES EAST 1213.3 FEET; THENCE SOUTH 61 DEGREES, 57 MINUTES WEST 182.7 FEET; THENCE NORTH 19 DEGREES, 35 MINUTES WEST 566.3 FEET; THENCE NORTH 21 DEGREES, 11 MINUTES EAST 794.1 FEET; THENCE NORTH 68 DEGREES, 20 MINUTES EAST 21.3 FEET TO THE PLACE OF BEGINNING, CONTAINING 5.00 ACRES, MORE OR LESS, SITUATED IN THE TOWNSHIP OF NAPERVILLE, COUNTY OF DUPAGE AND STATE OF ILLINOIS.

2.2 Site Description

The Site is comprised of approximately 27 acres of land and is currently improved as a public trap-shooting range operated by the NPD with assistance from the *Naperville Sportsman's Club*. The Site is owned by the City of Naperville and is maintained and managed by the NPD through a 99-year lease agreement that began in 1988.

Significant portions of the Site are covered by densely wooded vegetation and undergrowth. The central portions of the Site include permanent surface water features (North Pond, Central Equalization Channel, and South Pond) and associated buffering wetlands. The western and west-central Site areas contain the active and historic trap-shooting ranges and associated building structures (1-story club-house, detached storage garage, and trap-houses). Located within the northwestern portion of the Site exists a man-made soil berm formerly utilized as a bullet/projectile backstop for small arms shooting range activities. Other Site improvements

include a small gravel parking lot immediately west of the club-house, a gravel access road along the southern Site boundary, and a small gravel parking lot along the northeastern Site boundary used for permitted parking of Naperville Central High School. Site recreational improvements also include walking paths situated along the northern, west, and eastern Site boundary fence lines and a prairie restoration area that adjoins the northeastern parking lot.

Figure 2 identifies the existing Site features, structures, and includes the delineation of the remediation Site boundary. **Figure 3** includes a detailed plan view which identifies the related trap-shooting and former shooting range features, and includes a theoretical shot-fall zone projection.

The land use surrounding the property on the west is primarily single-family residential. South of the Site is the *Naperville Community Garden Plots*. East of the Site is the West Street right-of-way. Across West Street is a recreational park space commonly known as *Knoch Park North* and *Knoch Park South*. Adjoining the Site to the north is the *Von Oven Park* property which is utilized as a Scout camp.

2.3 Site Topography, Geology and Hydrogeology

2.3.1 Site Topography

The general topography of the Site is relatively flat-lying, with surface elevations range from approximately 701 to 719 feet above mean sea level (MSL). The 1993 USGS 7.5 minute topographic map depicts the Site water features (ponds and channel) as a depression (~699 feet above MSL). In general, the surrounding land elevation is higher to the north and lower to east of the Site. Surrounding elevations to the south and west are generally similar to that of the average Site elevations. **Figure 4** presents a Site topographic survey map.

Storm water runoff is expected to flow into the two Site ponds and equalization channel. During large rain events water from the south pond will overtop a discharge/control weir (set at ~700.01 ft. above MSL) and proceed off-site through a drainage channel at the southwest corner of the Site.

2.3.2 Site Geology

2.3.2.1 Geologic Literature Review

A review of available geologic reference literature was performed to develop a Site and regional geologic characterization;

The United States Department of Agriculture (USDA) Soil Conservation Service (SCS) State Soil Geographic Database (STATSGO) data indicates that the majority of the soils in the vicinity of the Site are classified as *Drummer*, with the remainder of the soils being classified as *Elliot*. *Drummer* is a silty clay loam that is poorly drained and a depth to water table of greater than 15 inches. *Elliot* is silty clay that is somewhat poorly drained and a depth to water table of greater than 41 inches. Other soil types in the area are described silty clay loam.

A review of the *Stack-Unit Mapping of Geologic Materials in Illinois to a Depth of 15 Meters (C542),* published by the Illinois State Geological Survey (ISGS), indicates that the Site is predominately underlain by the *Wedron Formation* (mainly silty and clayey diamictons) within 6 meters of the surface and greater than 6 meters in thickness.

The ISGS *Potential for Contamination of Shallow Aquifers from Surface and Near Surface*

Waste Disposal by Berg et al. (1984) classifies the western portion of the Site as "B2." B2 materials are described as "permeable bedrock, between 5 and 20 feet of surface, overlain by silty or clayey till and loess; relatively impermeable weathered zone in till." The potential for contaminating wells finished in B2 materials is characterized as high.

Review of ISGS map: *Surficial Geology of Naperville Quadrangle, DuPage County, Illinois*, indicate that the underlying materials consist primarily of silt, clay, and fine sand; stratified, laminated, and uniform; gray to brown, fossiliferous in many places; no more than 15 feet thick in most places. The Site is also underlain by diamictons**;** variably textured, inter-bedded with lenses of sand and gravel and less silt loam; three facies are identified based on mean values of texture, moisture content, and Atterberg limits (Landon and Kempton 1971, Curry 1991). Bedrock elevation below the Site is depicted as 650 feet above MSL.

2.3.2.2 Site Specific Geologic Data

Site specific geologic data was obtained through review of available subsurface soil boring logs completed during previous Site investigations and from soil boring and sampling data obtained during the Shaw 2012 investigations. The Site data indicates that subsurface conditions encountered generally consist of black to brown organic topsoil materials from surface grade to depths on average of 6 inches, underlain by fine grained materials (clays and silts) with intermingled sands and gravels at varying depths through the maximum depth of available data (~16 feet below surface grade). **Figure 5** presents a Site map illustrating the Shaw investigation sampling locations. **Figure 6** and **Figure 7** present generalized geologic cross sections depicting subsurface conditions across the Site.

A further discussion and presentation of Site specific subsurface investigation data is presented under report *Section 3.3.1 – Shaw Environmental Field Investigations.*

2.3.3 Hydrogeology

A Site hydro-geologic characterization was developed from the review of limited previous groundwater investigation data collected by other past consultants; from data obtained during the *Routine Wetland Assessment* (Shaw 2011); and from evaluation of recent groundwater investigation data (Shaw 2012).

Previously limited groundwater assessment data (TSC 1996) indicated the depth of shallow groundwater on Site ranged from approximately 8 feet to 13 feet below grade elevation with an apparent groundwater flow direction indicated as south-southeasterly.

Based upon the Shaw 2011 wetland assessment data, one wetland (Wetland 1) was identified on-Site. The wetland occupies the majority of the central portion of the Site and extends from the northern boundary to the southern boundary. Wetland 1 is a large wetland complex with several community types, including open water and emergent wetland. A discharge control structure (weir) existed at the southwestern edge of the South Pond. A culvert transports water under the gravel access road at the south end of the Site. At the north end of the North Pond, a corrugated steel pipe with a concrete flared end section connects the open water to a wooded area on the adjacent Von Oven Park property to the north.

The western portion of Wetland 1 is an emergent community dominated by reed canary grass (*Phalaris arundinacea*) and sandbar willow (*Salix interior*). The wetland also contained an open water pond connected to a linear open water feature (Equalization Channel). A copy of the Shaw 2011 *Wetland Assessment Report* in provided as **Appendix A.**

During advancement of the Shaw investigation soil borings (May 2012) shallow groundwater conditions were encountered at 6 boring locations (B-1 through B-4, B-6, and B-7) at depths ranging from 2 to 3 feet below surface grade. Significant portions of the wetland areas immediately south of the northwestern soil berm were inundated (i.e. standing surface water conditions) during the spring and summer season. During supplemental sampling events conducted in the fall season (October/November 2012) significant portions of the wetland and isolated portions of the equalization channel were "dry" with little to no standing water conditions evident. The investigation borings and monitoring well locations are depicted on **Figure 5**.

Based upon the Shaw groundwater elevation measurement data, local groundwater flow appears to be variable with easterly and westerly flow vectors indicated. The flow direction variability is influenced by the Site topography and temporal elevation fluctuations within the surface water bodies and within the emergent wetlands. **Figure 8** presents a potentiometric surface map illustrating the apparent groundwater flow conditions measured in May 2012 and includes the delineated boundary of the surveyed Site wetland.

2.4 Past Site Uses and Recognized Environmental Conditions

Based upon the historical use information obtained during the *Phase I ESA* (Shaw 2011) process, the Site was undeveloped land and part of a larger land parcel prior to 1938. In 1938, the Site was donated to the City of Naperville. The Site was leased to the *Naperville Sportsman's Club* from the City of Naperville from 1948 through 1988 for use as a shooting range. The Site ponds, channel, and north soil berm were created during this period by the *Sportsman's Club*. In 1988, the NPD assumed the lease of the Site for a term of 99 years. The NPD continues to control operations of the Site with assistance from the Naperville Sportsman's Club.

Three existing trap-shooting stations are located in the western portion of the Site arranged such that trap-shooting is directed toward the eastward direction. Historically, two trap-shooting stations were located approximately 100 feet east of the southernmost existing trap-shooting stations. Other former sport shooting activities included a small arms firing range located along the northwestern soil berm. The primary shooting line of fire was directed towards the south face of the soil berm.

The Site has been the subject of multiple soil and groundwater investigations in the late 1980s and 1990s. Following investigation activities, the portion of the Site accessible to the general public located outside the existing fence was voluntarily enrolled in the IEPA/SRP in 1995. The results of the multiple investigations indicate that soils exceeded the most stringent IEPA Remedial Objectives for Total Lead and Poly-nuclear Aromatics (PNAs). The results of the previous groundwater investigations did not indicate a risk to the groundwater ingestion exposure pathway. A portion of the Site located outside of the current shooting range fence line was issued a *no further remediation* determination for Total Lead in October 1998.

In 1999 the Site was the subject of a United State Environmental Protection Agency (USEPA) investigation under the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) program, however, the Site was not included on the National Priorities List (NPL).

Discharges from the Site ponds are currently regulated under a National Pollutant Discharge Elimination System (NPDES) permit (#IL0073253). In compliance with the permit, preventative measures for the balance of the Sportsman's Park property were implemented including limiting access to the gun range areas, posting signage and implementing environmental best management practices at the Park, including the required use of environmentally friendly steel

shot, biodegradable targets and banning lead-shot from continued use at the Site. **Appendix M** contains a copy of the existing Site NPDES Permit as issued by IEPA.

Based upon the historical use information reviewed and presented within the Phase I ESA process (Shaw 2011) the following *recognized environmental condition(s)* with respect to the Site were identified:

> *"Historic gun range activities at the Subject Property included the use of Lead shot and PNA-bearing clay trap targets. Soil sampling activities conducted within the limited access portions of the Subject Property indicate the presence of Lead and PNAs at concentrations above the most stringent IEPA Tier 1 Soil Remedial Objectives for public use facilities. The documented presence of soil impact above the most stringent IEPA Remedial Objectives constitutes a recognized environmental condition".*

Based on the above identified *REC* and data obtained during previous environmental investigation activities, physical investigations were further warranted to characterize and evaluate environmental impacts to Site soils, sediments, groundwater and surface water resources. The following report sections summarize the physical (focused) Site investigation activities.

3.0 INVESTIGATION METHODOLOGIES

3.1 Statement of Quality Assurance

Shaw personnel arranged, directed and performed all field investigation activities. Shaw personnel documented all field activities necessary to complete the focused investigation. All sampling procedures were performed according to the standards set forth by the USEPA and the American Society for Testing and Materials (ASTM). Field measurements were taken using a tape measure, measuring wheels, Global Positioning System (GPS) receiver, Total Station and other calibrated field survey instrumentation.

X-Ray Fluorescence (XRF) soil and sediment screening analyses were performed by trained and certified Shaw personnel and conducted in accordance with the provision of USEPA Method 6200 - *Field Portable XRF Spectrometry for the Determination of Elemental Concentrations in Soil and Sediment.*

All laboratory analyses were completed by Test America Chicago of University Park, Illinois. Test America Chicago is considered a National Environmental Laboratory Accreditation Program (NELAP) Laboratory and is federally accredited through the U.S. Army Corps of Engineers (USACE), Air Force Center for Engineering and the Environment (AFCEE), and Naval Facilities Engineering Service Center (NFESC). Test America Chicago is listed as an IEPA Accredited Environmental Laboratory, in accordance with Title 35 of the Illinois Administrative Code, Part 186, *Accreditation of Laboratories for Drinking Water, Wastewater and Hazardous Waste Analysis.* A copy of the applicable analytical laboratories certifications are presented in **Appendix B**.

Reviewed laboratory analyses were completed by the qualified environmental laboratory using Level 2 Quality Assurance/Quality Control (QA/QC) criteria equivalent to EPA and/or laboratory specifications. In order to meet the Level 2 data validation objectives for this project, Shaw received Level 2 QA/QC data deliverables. This data package included a transmittal letter,

sample analytical results, method blank results, and surrogate recovery results where applicable. The results of matrix spiked samples and either duplicate samples or duplicate matrix spike samples, were also included as part of the Level 2 QA/QC report deliverables.

Shaw attests to the extent practically reviewable, that information, data, and resulting decisions are technically sound, statistically valid, and properly documented. Any exception to the above statement is specifically noted below:

- The laboratory method detection limit is greater than the pH specific remediation objective for Silver in soil samples E15 (0-6"), G7 (0-6"), G13 (0-6"), G15 (6-12"), G17 (0-6"), M15 (6-12"), and M19 (0-6").

- The laboratory method detection limit is greater than the Construction Worker soil inhalation remediation objective for Naphthalene in soil samples H18 (0-6"), E18(N15',S5') (0-6"), G17 (0-6") and D14(N15',W10') (0-6").

- Thirty-six lab analyses for sediment samples E24 (0-6"), G9 (0-6"), G19 (0-6"), G19 (6-12"), I9 (0-6"), I9 (6-12"), I18 (0-6"), J4 (0-6"), J13 (0-6"), J24 (0-6"), K7 (0-6"), K7 (6-12"), K11 (0-6"), L5 (0-6"), F20 (0-6"), H20(E20') (0-6"), K10(W25') (0-6"), H10(N30') (0-6"), J8 (0-6"), L6(W20') (0-6"), J17(N30',W20') (0-6") and K12(W25') (0-6") were indicated as non-detect for Anthracene, Dibenz(a,h)anthracene, Fluorene, and Naphthalene, where the laboratory method detection limits were greater than the Baseline Sediment Objectives.

- The laboratory method detection limit was greater than the most stringent surface water remediation objectives for Anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Dibenz(a,h)anthracene, and Indeno(1,2,3-cd)pyrene in surface water samples SW-1, SW-4 & SW-6.

- The laboratory method detection limit was greater than the TCLP Soil Component of the Class I Groundwater Remediation Objective for lead in soil sample C7 (6-12").

3.2 Data Collection

Data collection activities were completed in general compliance with the applicable Shaw Standard Operation Procedures (SOPs). Shaw professionals and subcontractors have also been trained in accordance with Occupational Safety and Health Administration (OSHA) standard 29 CFR 1910.120, *Hazardous Operation and Emergency Response Guidelines*. All Shaw personnel and individuals involved with Shaw directed Site activities were required to conform to a Site-specific *Health and Safety Plan* prepared by the Shaw Health and Safety Officer. Soil, sediment, surface water and groundwater samples were collected using a systematic approach that ensured the data gathered is representative of the Site geological and environmental conditions.

3.3 Field Methodologies and Sample Collection Procedures

The following report sections provide a discussion of the scope, methodologies and procedures utilized to complete the *FSI* in accordance with the IEPA/SRP approved *Revised Site Investigation Work Plan (Revised SIWP)* and associated *Response to IEPA Comments*, dated January 10, 2012.

Data obtained during the Site investigation activities has been incorporated within this report in

the form of scaled Site plans, tabulated analytical results, laboratory chemical analysis reports, soil boring logs, monitoring well construction records and other data documentation, and are provided in the relevant attachments and appendices of this report.

3.3.1 Shaw Environmental Field Investigations

Shaw conducted investigation activities in several phases from March 2012 through November 2012. The systematic investigation tasks included: 1) pre-investigation Site survey to establish a sampling grid and sample location coordinates; 2) geologic and hydro-geologic assessment through soil borings, monitoring well installations, and groundwater/surface water sampling and evaluation activities; 3) collection and XRF screening of surface and near-surface soil and sediment samples; and 4) collection and laboratory analysis of supplemental soil, sediment, groundwater and surface water data following the evaluation of the initial screening and confirmation laboratory analytical results.

The following report sections provide a detailed description of the Site investigation field activities. Photographic documentation of various field investigation activities is included in **Appendix C**.

3.3.1.1 Site Surveying and Sample Location Control

Soil, sediment, surface water, soil borings and monitoring wells were surveyed using either a Trimble™ GeoXH Global Positioning System (GPS) receiver and/or a TopCon™ total station to obtain positional data at each sampling location. All positional data was collected utilizing the Illinois State Plane East, 1983 North American Datum (NAD) coordinates system. Collected GPS data was post-processed to achieve sub-meter accuracy. At each primary sampling grid node, (100 foot by 100 foot spacing) a labeled survey stake/marker was placed to establish and identify an alpha-numeric grid location. Sampling locations which did not coincide to a primary grid node were identified by reference to the nearest primary grid node with cardinal direction offset distances (i.e. F5 (E30', S12')).

At each monitoring well point, ground surface, top-of-casing and top-of-riser elevations were surveyed by Shaw personnel using industry standard leveling techniques. Known Site elevation benchmarks were utilized for survey elevation control.

3.3.1.2 Equipment Decontamination

Prior to use at the Site and between sampling locations, all downhole drilling and sampling equipment, including augers, drilling rods, Macro-Core™ samplers, and hand tools were decontaminated. The purpose of decontamination was to prevent potential cross-contamination between sampling locations and sample intervals. Drilling decontamination procedures consisted of using a steam-generating pressure washer and potable water to remove soil and other debris from the equipment. The field scientist's logging and sampling tools (hand-auger sampler, sediment sampler core tubes and stainless steel sampling trowel, etc.) were washed using a scrub brush in a solution of potable water and a non-phosphate detergent. Washed equipment was double-rinsed with distilled water and dried between uses. In addition, disposable acetate liners were also utilized to minimize potential cross-contamination.

3.3.1.3 Soil Borings

Shaw advanced seven (7) soil borings in April 2012 for the purpose of developing a Site wide sub-surface geologic profile. The borings are identified as B-1 through B-7 and were made using a track mounted GeoProbe™ direct-push drilling unit utilizing a 4-foot by 2-inch outside

diameter Macro-Core™ Sampler. At each boring location monitoring well points were also established (refer to *Report Section 3.3.1.4* for details).

Representative soil samples were preserved in the field, in appropriate-sized, sterile glass containers with twist-on, Teflon™ lined lids, as supplied by the contract environmental laboratory. Immediately after filling, labeling and sealing the sample containers, the containers were placed into a cooler on ice, for the duration of the daily field activities. The samples were then transported to the contract laboratory under standard chain-of custody procedures. Selected soil samples were submitted to the contract environmental laboratory for chemical analysis of Resource Conservation and Recovery Act (RCRA) 8-Total Metals, plus Antimony, Copper, and Zinc, pH and PNAs.

A Shaw environmental scientist was on-Site to oversee and document the drilling operations. The scientist was responsible for characterizing the soils encountered, preserving representative samples, and maintaining Daily Field Reports. Soil samples were logged on standardized forms in accordance with the *Unified Soil Classification System*, ASTM D 2487. Copies of the Shaw Soil Boring Logs are included as **Appendix D**. The soil boring locations are depicted on **Figure 5**.

3.3.1.4 Monitoring Well Installation/Development

The monitoring wells installed by others during previsous investigations are designated as MW-1 through MW-3. Shaw converted the seven (7) newly installed soil borings (B-1 through B-7) to groundwater monitoring wells MW-4 through MW-10, respectively. The monitoring well locations are depicted on **Figure 4**. The purpose of the monitoring wells was to facilitate measurement of local groundwater conditions and collection of representative groundwater samples to evaluate the Groundwater Ingestion Exposure Pathway as defined in *TACO* and to complete a Focused Site characterization for Metals and PNAs.

Each monitoring well was constructed of 2-inch diameter, Schedule 40 PVC materials. An approximate 10-foot long slotted well screen (0.010-inch slots) with end cap was installed at the bottom of the borehole and flush-threaded riser sections were added as necessary to extend the well casing above ground surface. A sand pack was installed in the borehole annulus to approximately 1 foot above the elevation of the top-of-screen. A granular bentonite seal was then placed, and hydrated, above the sand pack to approximately 1 foot below the ground surface. The top-of-casing was then cut off to approximately 3 feet above the ground surface and finished with a locking well cap and steel stick-up wellhead protector installed in concrete over the top-of-casing. The Shaw field scientist completed a Well Construction Report for each well. Copies of the Shaw Monitoring Well Construction Reports are included in **Appendix E**.

After installing the monitoring wells, Shaw personnel returned to the Site to obtain well elevation survey data and develop the monitoring wells. The purpose of development was to ensure the monitoring well screens were not clogged, establish a connection with the surrounding water bearing materials and ensure wells function as intended. Well development methods consisted of using a disposable bailer to surge and purge the well screen intervals. A minimum of ten (10) well volumes were purged from each well and/or purged until well was dry.

3.3.1.5 In-Situ Hydraulic Conductivity Measurement

On May 22, 2012, Shaw personnel completed *in-situ* hydraulic conductivity tests (variable head tests) at monitoring wells MW-2, MW-5, MW-7, MW-8, and MW-9. An electronic data logger and a pressure transducer (Level-troll™) were used to record all data throughout the tests. The variable head (rising head) tests were performed by submerging a 3-foot long, sampling bailer

into the well, and then rapidly retracting the water "slug", thus inducing an instantaneous change to the water level. The resultant change in head versus time data was recorded until the water level stabilized. Upon completion of the tests, the data was downloaded and conductivity values were calculated utilizing AQTESOLV® software. Copies of the Shaw hydraulic conductivity test data and AQTESOLV® results are included in **Appendix F**.

3.3.1.6 Groundwater Sampling Methodologies

On August 22-23, 2012, Shaw personnel returned to the Site to obtain representative groundwater samples from the monitoring wells. Prior to sampling the wells, Shaw used an electronic water level indicator to measure static water levels inside the well casings. This information was used to determine the well volume. A low-flow sampling pump, with a flow rate of 0.1 to 0.5 liters/minute, was used to micro-purge and sample the monitoring wells. Groundwater water quality parameters (pH, temperature, turbidity, conductivity, and dissolved oxygen) were obtained from each monitoring well location at 3 minute intervals until stabilization was achieved, at which time samples were obtained. **Appendix G** contains copies of the groundwater purge and sampling logs.

New sampling equipment was utilized at each monitoring well location to prevent cross-contamination between well locations. Sample containers, as supplied by the contract environmental laboratory, were filled directly from the sampling equipment. Immediately after filling, labeling and sealing the sample containers, the containers were placed into a cooler on ice or the duration of the daily field activities, and until to samples were transported to the contract laboratory under standard chain-of-custody procedures. All groundwater samples were submitted to the contract environmental laboratory for chemical analysis of RCRA 8-Total Metals, plus Antimony, Copper, and Zinc, and PNAs.

3.3.1.7 Surface and Near Surface Soil Sampling

Previous investigations indicated that impact from the historic shooting activities is primarily located in the upper soil horizon, therefore soil samples were collected from depths representative of 0-6 inches, 6-12 inches, and 12-18 inches below ground surface.

Beginning in April 2012 through June 2012 Shaw personnel conducted initial surface/near-surface sample collection, XRF screening and evaluations of the upper soil horizon. During October and November 2012, Shaw also conducted supplemental sampling activities in an effort to delineate the extent of Site impacts identified during the initial characterization.

Surface and near surface soil samples were obtained at the trapshooting range areas on both sides of the existing Site channel, at the former small arms shooting range impact berm-face and range floor areas, and the balance of areas which defines the Sportsman's Park property. The soil grid sampling locations are depicted on **Figure 5**.

Soil samples were collected utilizing hand sampling tools (hand augers, core-samplers, sampling trowel/spade, etc.). Upon collection, samples were containerized in sterile plastic and/or glass sample containers. Immediately after filling, labeling and sealing the sample containers, the containers were placed into a cooler on ice, for the duration of the daily field activities.

Soil samples collected for XRF screening in accordance with USEPA Method 6200 procedures were prepared by homogenizing each sample within a stainless steel mixing bowl and containerized in a clean sample bag prior to XRF testing. Soil samples selected for confirmation laboratory analyses were re-containerized in sterile glass sample containers with screw-on

Teflon™ lids as provided by the contract laboratory. All soil samples selected for confirmation analyses were transported to the contract laboratory under standard chain-of-custody procedure. **Appendix H** contains a tabularized summary of the XRF screening results.

During this investigation a total of 303 surface/near-surface soil samples were collected for XRF analyses. A total of 201 soil samples were submitted to an environmental laboratory for analysis of one or more of the following focused contaminants of concern: RCRA 8-Total Metals, Antimony, Copper, Zinc and pH. A total of 95 samples were selected and submitted for various Toxicity Characteristic Leaching Procedure (TCLP) Metals analyses. A total of 61 soil samples were selected and submitted for laboratory analysis of PNAs.

3.3.1.8 Sediment Sampling

Sediment sampling was conducted within the Site ponds, channel, and wetland areas as surface water features are in-part located within the projected shot-fall and bituminous clay target break zones. The sediment sampling locations are depicted on **Figure 5**. Shaw personnel conducted an initial sediment sampling event during April/May 2012 and a supplemental sediment sampling event in November 2012 in an effort to further define sediment impacts.

Sediment samples were collected utilizing a hand-driven, stainless steel multi-stage sediment core-sampler with inserted disposable acetate liners. Sediment samples were collected at intervals representative of 0-6 inch, 6-12 inch and 12-18 inch depths.

Upon collection, samples were removed from the core-sampler, capped, and sealed. Each sediment sample core was labeled and placed into a cooler on ice for the duration of the daily field activities and until transport to the contract laboratory. All sediment samples selected for confirmation analyses were transported to the contract laboratory under standard chain-of-custody procedure.

During the sediment investigation a total of 41 sediment samples were collected from 20 discrete sampling points. Selected sediment samples were submitted for analysis of one or more of the following focused contaminants of concern: RCRA 8-Total Metals, Antimony, Copper, Zinc, pH, PNAs, and Organic Carbon Fraction (FOC). A total of 34 sediment samples were also selected and analyzed for TCLP RCRA 8-List Metals.

3.3.1.9 Surface Water Sampling

In late May and early November 2012 Shaw personnel conducted surface water sampling events. A total of six (6) water grab samples were initially obtained from the North Pond, Equalization Channel, and South Pond locations. The collected samples are identified as SW-1 through SW-6. The surface water sampling locations are depicted on **Figure 5**.

The water samples were collected with a disposable plastic sample jar at each location, and decanted/transferred to preserved and unpreserved glass and/or plastic sampling containers as provided by the contract laboratory. Each water sample container was labeled and placed into a cooler on ice, for the duration of the daily field activities and until transport to the contract laboratory. All water samples were transported to the contract laboratory under standard chain-of-custody procedure.

The six (6) water samples collected during the May 2012 sampling event were analyzed for the inorganic focused contaminants of concern: RCRA 8-Total Metals, Antimony, Copper, and Zinc. Three (3) selected water sample were also submitted for analysis of PNAs and Total Hardness.

The six (6) additional water samples collected during the November 2012 sampling event were only analyzed for Total Lead and Dissolved Lead parameters.

4.0 SUMMARY OF INVESTIGATION RESULTS

4.1 Site Geology and Groundwater Conditions

The Site data indicates that subsurface conditions encountered generally consist of black to brown organic topsoil materials from surface grade to depths on average of 6 inches, underlain by fine grained materials (clays and silts) with intermingled sands and gravels at varying depths through the maximum depth of available data (~16 feet below surface grade). **Figure 6** and **Figure 7** present generalized geologic cross sections depicting subsurface conditions across the Site.

Groundwater elevation data was obtained from the seven Shaw monitoring well locations (MW-4 through MW-10) and the pre-existing monitoring wells (MW-1 through MW-3). This information was utilized to characterize the local groundwater elevations and apparent flow direction. The groundwater measurement data obtained over the course of the Shaw investigations are summarized in the below **Table 4.1.**

Table 4.1
Groundwater Elevation Measurement Results

Measurement Date:			04/17/2012		05/3/2012		05/22/2012		6/12/2012		10/16/2012	
Well ID	Top of Riser Elev.	Ground Elev.	Depth to Water	Water Elev.	Depth to Water	Water Elev.	Depth to Water	Water Elev.	Depth to Water	Water Elev.	Depth to Water	Water Elev.
	Above msl	Above msl	(ft)	Above msl	(ft)	Above msl	(ft)	Above msl	(ft)	Above msl	(ft)	Above msl
MW-1	706.71	704.67	---	---	12.81	693.90	13.03	693.68	14.65	692.06	17.66	689.05
MW-2	702.85	701.02	---	---	7.51	695.34	7.61	695.24	8.56	694.29	12.52	690.33
MW-3	705.85	703.41	---	---	16.64	689.21	16.29	689.56	17.70	688.15	20.25	685.60
MW-4	703.58	703.83	2.82	700.76	3.11	700.47	3.42	700.16	4.35	699.23	8.79	694.79
MW-5	706.10	702.90	---	---	12.40	693.70	10.39	695.71	12.54	693.56	13.20	692.90
MW-6	705.22	702.42	6.07	699.15	6.74	698.48	7.15	698.07	8.53	696.69	14.76	690.46
MW-7	707.37	704.47	---	---	11.93	695.44	9.02	698.35	10.50	696.87	14.59	692.78
MW-8	704.13	701.18	14.02	690.11	11.01	693.12	6.08	698.05	5.66	698.47	N/A	N/A
MW-9	704.83	702.59	6.61	698.22	7.26	697.57	7.67	697.16	8.84	695.99	13.13	691.70
MW-10	701.78	702.01	1.51	700.27	1.77	700.01	2.68	699.10	3.69	698.09	5.70	696.08

--- Groundwater not encountered

Based upon the Shaw groundwater elevation measurement data local groundwater flow appears to be variable with both easterly and westerly flow vectors indicated. The flow direction variability is influenced by the Site topography, temporal fluctuations of the surface water elevation and emergent wetland conditions. **Figure 8** presents a potentiometric surface map illustrating the apparent May 2012 groundwater flow conditions and also illustrates the delineated Site wetland boundary. Based on the May 2012 data groundwater gradients ranged from 0.001 ft/ft. to 0.007 ft/ft.

On May 22, 2009, Shaw personnel completed *in-situ* hydraulic conductivity tests (variable head tests) at monitoring wells MW-2, MW-5, MW-7, MW-8, and MW-9. Upon completion of the tests, the data was downloaded and conductivity values were calculated utilizing AQTESOLV software. The results of the aquifer testing are summarized in **Table 4.1.1** below:

Table 4.1.1
Hydraulic Conductivity Testing Results

Monitoring Well	Date	K Value by Rising Head Permeability (cm/sec)
MW-2	05/22/2012	5.754×10^{-5}
MW-5	05/22/2012	1.608×10^{-5}
MW-7	05/22/2012	1.501×10^{-5}
MW-8	05/22/2012	2.067×10^{-5}
MW-9	05/22/2012	6.761×10^{-4}
Geometric Mean:		**4.546×10^{-5}**

The geometric mean of the variable head tests indicates a hydraulic conductivity (K) of 4.546×10^{-5} cm/sec for the Site. Copies of the Shaw Hydraulic Conductivity Test Data and AQTESOLV Results are included in **Appendix F**.

4.2 Summary of Soil Sample Analytical Results

Laboratory analysis of soil samples were performed at the contract environmental laboratory in accordance with methodologies specified in the latest edition of USEPA Publication Number SW-846, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*. The specific analytical methods were as follows:

Primary Analytical Suites

- Total Metals – Methods 6010B/7471A
- Soil pH – Method 4500H+B
- PNA – Methods 8270C

Secondary Analytical Suites (select soil samples)

- TCLP Metals - Methods 6010B/7470A

The soil sample laboratory analytical results are summarized in attached **Table A** through **Table C**. For evaluation purposes, included on the tables are the Tier 1 Remediation Objectives, taken from Title 35 of the Illinois Administration Code, Part 742, *Tiered Approach to Corrective Action Objectives (TACO)*. Results that exceed the *TACO* Tier 1 objectives are bold and shaded on the tables. Copies of the laboratory analytical reports including Level 2 QA/QC data deliverables are included in **Appendix I.**

The *TACO* objectives are provided as an initial gauge of the level of impacts the Illinois Environmental Protection Agency deems acceptable for a given land use, e.g., residential or industrial/commercial. The following is a summary of the soil sampling results and indication of the Contaminants of Concern (COCs) that exceeded the most stringent and applicable Tier 1 Soil Remediation Objectives (SROs) considering Class I Groundwater and Residential Land Use.

4.2.1 Poly-nuclear Aromatics (PNAs) in Soil

A total of Sixty-one (61) soil samples were submitted for laboratory analysis of PNAs. Twenty-three (23) of the tested samples detected one or more of the following list of PNA compounds at concentrations exceeding one or more of the most stringent *TACO* Tier 1 SROs; including the Soil Component to Class I Groundwater Ingestion Objectives, Residential Soil Ingestion Objectives, Construction Worker Soil Ingestion Objectives and/or the Construction Worker Soil Inhalation Objectives:

- Benzo(a)anthracene,
- Benzo(a)pyrene,
- Benzo(b)fluoranthene,
- Benzo(k)fluoranthene,
- Chrysene,
- Dibenzo(a,h)anthracene,
- Indeno(1,2,3-cd) pyrene, and
- Naphthalene.

The soil PNA laboratory analytical results are summarized in **Table A**. **Figure 9** presents a Site map indicating the estimated aerial extent of the PNA soil impacts.

4.2.2 Total Metals and pH in Soil

Two hundred and one (201) soil samples were submitted for laboratory analysis of Total Lead, with 175 respective pH samples. Seventy five of the aforementioned samples were also analyzed for total RCRA 8 Metals plus Antimony, Copper, and Zinc. Sixty-five (65) of the tested samples detected concentrations of Total Metals (Lead, Arsenic, Antimony, and Mercury) at concentrations exceeding one or more of the most stringent *TACO* Tier 1 SROs including; the Soil Component to Class I Groundwater Ingestion Objectives, Residential Soil Ingestion Objectives, Residential Soil Inhalation Objectives, Construction Worker Soil Ingestion Objectives and/or the Construction Worker Soil Inhalation Objectives.

The soil Total Metals and pH results are summarized on **Table B** and **Table C. Figures 10** through **Figure 12** presents Lead-in Soil Iso-concentration Diagrams indicating the aerial extent of the identified Lead impacts for the 0-6 inch, 6-12 inch and 12-18 inch depth profiles.

4.2.3 TCLP Metals Analysis in Soil

Toxicity Characteristic Leaching Procedure (TCLP) analyses were completed on ninety-five (95) select soil samples with elevated Total Metal concentrations and/or were selected from other areas to delineate characteristically “hazardous” lead in soil conditions.

Twenty-seven (27) of the soil samples detected TCLP Lead concentrations >5 mg/L. The soil TCLP laboratory analytical results are summarized on **Table D**. **Figure 13** through **Figure 15** presents iso-concentration diagrams indicating the aerial extent of identified TCLP Lead impacts for the 0-6 inch, 6-12 inch and 12-18 inch soil profiles.

Additionally, based on the TCLP results, 79 of the 95 tested samples also exceeded the Tier 1 Class I Soil Component of the Groundwater Ingestion Exposure Route SRO for Lead of 0.0075 mg/L; 17 samples exceeded the Tier 1 Class I Soil Component of the Groundwater Ingestion Exposure Route SRO for Arsenic of 0.05 mg/L, and 2 samples exceeded the Cadmium objective of 0.005 mg/L.

4.3 Summary of Groundwater and Surface Water Sample Analytical Results

The primary analytical suite for the nine (9) groundwater samples and six (6) surface water samples collected consisted of RCRA 8 Total Metals (Lead, Arsenic, Barium, Cadmium, Chromium, Mercury, Selenium, and Silver) plus Antimony, Copper, Zinc, and PNAs. Secondary testing of surface water included Total Hardness and Dissolved Lead parameters.

Laboratory analysis of groundwater samples were performed at the contract environmental laboratory in accordance with methodologies specified in the latest edition of USEPA Publication Number SW-846, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*. The specific analytical methods were as follows:

- Total Metals – Method 6020/7470A
- PNAs/ Semivolatile Organic Compounds (GC/MS) – Method 8270C
- Hardness as Calcium Carbonate- Method SM2340B
- Dissolved Lead – Method 6020

The groundwater and surface water grab sample analytical results are summarized in the attached **Table E** and **Table F,** respectively.

For evaluation purposes, included on the tables are the applicable *TACO* Tier 1 Groundwater Remediation Objectives (GROs) considering a Class I Groundwater designation and Surface Water Quality Standards. Copies of the Shaw groundwater investigation laboratory analytical reports including Level 2 QA/QC data deliverables are included in **Appendix J**.

The objectives are provided as an initial gauge of the level of impacts the IEPA deems acceptable specifically considering the underlying groundwater classification in accordance with the requirements of Illinois Administrative Code (IAC) Part 620, Groundwater Quality regulations and surface water impacts pursuant to IAC Part 302 Water Quality Standards.

4.3.1 Poly-nuclear Aromatics (PNAs) in Groundwater and Surface Water

Nine (9) groundwater samples were collected during the April/May 2012 *FSI* investigation and were submitted for laboratory analysis of PNAs. Based upon the groundwater results 1 sample collected from MW-8 detected Benzo(a)anthracene at 0.00014 mg/L, slightly exceeding the Class I GRO of 0.00013 mg/L. None of the other groundwater samples detected PNA compounds above the laboratory detection limits.

Three (3) surface water samples were submitted for laboratory analysis of PNAs. Analytical results did not detect the presence of PNAs at concentrations above the laboratory detection limits.

4.3.2 Total Metals in Groundwater and Surface Water

Nine (9) groundwater samples were collected during the April/May 2012 *FSI* investigation and were submitted for laboratory analysis of Total Metals. Analytical results did not detect the presence of any Total Metal at concentrations above the applicable Class I GROs.

Six (6) surface water samples were also collected during the April/May 2012 *FSI* investigation and were submitted for laboratory analysis of Total Metals. Based upon the surface water Total Metal results, 1 of the 6 tested samples (SW-1) contained a Total Lead concentration of 0.17 mg/L, apparently exceeding the General Use-Chronic Standard.

In order to evaluate the potential for suspended solid bias, six (6) additional surface water samples were collected and submitted to the contract laboratory for Total Lead and Dissolved Lead parameter in November 2012. Based on the supplemental surface water sampling results, the General Use-Chronic Standard for Lead has not been exceeded.

It is important to note that the 2000 NPDES permit for the site requires that storm water discharges from the Site be monitored for total Lead and PNAs. The previously submitted Phase I ESA contains a detailed description of the monitoring history and the analytical results associated with the ongoing monitoring. In summary, during the monitoring period of January 2000 through January 2011, discharge events from the outfall were limited to 16 monthly reporting periods. During sampling events, priority PNA levels have not exceeded the method detection limits. Total Lead levels have been below the water quality standards and permit action levels, with the exception of the March 2010 sampling period. Following a statement from the laboratory and subsequent re-sampling, this sole exceedance was suspected to be influenced by turbidity in the sample specimen.

4.4 Summary of Sediment Sample Analytical Results

Laboratory analysis of sediment samples were performed at the contract environmental laboratory in accordance with methodologies specified in the latest edition of USEPA Publication Number SW-846, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*. The specific analytical methods were as follows:

Primary Analytical Suites

- Total Metals – Methods 6010B/7471A
- Soil pH – Method 4500H+B
- PNA – Methods 8270C

Secondary Analytical Suites (select soil samples)

- TCLP Metals - Methods 6010B/7470A
- Fractional Organic Carbon (foc) – ASTM Method D2974-87

Unlike soils, groundwater and surface water evaluations, the IEPA Tiered Approach to Corrective Action Objectives (TACO) guidelines do not contain remedial objectives for sediment materials. For initial sediment screening evaluation purposes, results were compared, where applicable to:

1) IEPA Tier 1 Baseline Sediment Objectives as listed within the *Draft – Update 4, Table 1 – Tiered Approach For Evaluation and Remediation of Petroleum Product Releases to Sediments*, dated May 4, 2009;

2) USEPA Sediment Quality Guideline Objectives as provided within *Prediction of Sediment Toxicity using Consensus-Based Freshwater Sediment Quality Guidelines (USEPA Publication 905/R-00/0070*), dated June 2000 and,

3) Toxicity Characteristic Threshold Objectives as listed in 40 CFR Part 261.24 – *Toxicity Characteristics; Table 1 – Maximum Concentration of Contaminants for Toxicity Characteristics*.

Sediment sample laboratory analytical results are summarized in the attached **Table G** through **Table H**. Results that exceed the initial screening objectives are bold and shaded on the tables. All sediment sample results are reported on a dry weight basis. Copies of the sediment sample

laboratory analytical reports including Level 2 QA/QC data deliverables are included in **Appendix K.**

4.4.1 Sediment Sample PNA Results

Forty-one (41) sediment samples were submitted for laboratory analysis of PNAs. Twelve (12) samples detected various PNA compounds (Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Chrysene, and Dibenzo(a,h)anthracene) at concentrations exceeding either the IEPA baseline Sediment Remediation Concentrations (SRCs) and/or the USEPA consensus-based Probable Effect Concentrations (PECs). Sediment sample PNA laboratory analytical results are summarized on **Table G.** Results that exceed the initial screening objectives are bold and shaded on the tables. **Figure 16** presents a Site diagram indicating the estimated extent of PNAs in sediment impacts.

4.4.2 Sediment Sample Total Metals Results

Forty-one (41) sediment samples were submitted for laboratory analysis of Total Metals. Fifteen (15) samples detected one or more Total Metals (Lead, Arsenic, Copper, Zinc, & Chromium) at concentrations exceeding the USEPA consensus-based PECs.

Sediment sample Total Metals laboratory analytical results are summarized on attached **Table H.** Results that exceed the initial screening objectives are bold and shaded on the tables. **Figure 17** presents a Site diagram indicating the estimated extent of metals impacted sediments.

4.4.3 Sediment Sample TCLP Metals Results

Thirty-four (34) sediment samples were submitted for laboratory analysis of TCLP Metals analyses. Nine (9) samples detected TCLP Lead at concentrations exceeding the RCRA Toxicity Characteristic (TC) threshold concentration of 5.0 mg/L. Sediment sample TCLP Metals laboratory analytical results are summarized on attached **Table H.** Results that exceed the TC threshold are bold and shaded on the tables. **Figure 18** presents a Site diagram indicating the estimated extent of characteristically hazardous Lead sediment impacts.

5.0 ENDANGERMENT ASSESSMENT

In order to demonstrate that any contaminants of concern does not pose a risk to human health or the environment, an evaluation of the potential exposure pathways must be performed. In accordance with the *TACO* regulations, elimination of the potential exposure pathways can be accomplished through physical remediation, the use of engineered barriers and institutional controls, preventative measure or a combination of strategies. The potential exposure pathways that must be evaluated consist of:

- Soil Ingestion (including Construction Worker Ingestion);
- Soil Inhalation (including Construction Worker Inhalation);
- Soil Component of Migration to Groundwater
- Groundwater Ingestion;
- Sediment and Surface Water Receptors, and,
- Other Potential Pathways (i.e. man-made migration routes)

5.1 Soil Ingestion Exposure Pathway

Evaluation of the soil ingestion pathway was accomplished by directly comparing the analytical results for all soil samples obtained to the most stringent Tier 1 Soil Remediation Objectives for the Residential Ingestion Exposure Pathway and the Construction Worker Ingestion Exposure Pathway as listed in *TACO*.

5.1.1 Residential Soil Ingestion

Results of this investigation identified that the Soil Remediation Objectives for the Residential Ingestion Exposure Pathway have been exceeded in numerous samples and are summarized in **Table 5.1.1** below:

Table 5.1.1
Summary of Residential Soil Ingestion Exposure Pathway Exceedances

Sample Location	Sample Interval	Contaminant of Concern	Residential Ingestion SROs (mg/kg)	Sample Result (mg/kg)
A5 (E25, S35)	0-6”	Lead	400	780
C5.5	0-6”	Benzo(a)pyrene	0.09	0.24
	12-18”	Lead	400	430
C13	0-6”	Benzo(a)pyrene	0.09	0.24
C17	0-6”	Benzo(a)pyrene	0.09	0.12
E15	0-6”	Benzo(a)anthracene	0.9	150
		Benzo(a)pyrene	0.09	93
		Benzo(b)fluoranthene	0.9	51
		Benzo(k)fluoranthene	9.0	20
		Chrysene	88	280
		Dibenzo(a,h)anthracene	0.09	29
		Indeno(1,2,3-cd)pyrene	0.9	19
E19	0-6”	Benzo(a)pyrene	0.09	0.24
F5 (E35, S12)	0-6”	Lead	400	910
G5.5	0-6”	Arsenic	13	26
		Benzo(a)pyrene	0.09	0.21
G13	0-6”	Lead	400	3000

Sample Location	Sample Interval	Contaminant of Concern	Residential Ingestion SROs (mg/kg)	Sample Result (mg/kg)
I11	0-6”	Antimony	31	67
		Arsenic	13	56
		Lead	400	5600
I11	6-12”	Lead	400	90000
I13	0-6”	Antimony	31	3100
		Arsenic	13	1200
		Lead	400	110000
I13	12-18”	Lead	400	580
I15	0-6”	Antimony	31	610
		Arsenic	13	280
		Lead	400	94000
		Benzo(a)anthracene	0.9	110
		Benzo(a)pyrene	0.09	130
		Benzo(b)fluoranthene	0.9	140
		Benzo(k)fluoranthene	9.0	78
		Chrysene	88	130
		Dibenzo(a,h)anthracene	0.09	22
		Indeno(1,2,3-cd)pyrene	0.9	64
I17	0-6”	Lead	400	500
I19	0-6”	Benzo(a)pyrene	0.09	0.27
K15	0-6”	Antimony	31	7100
		Arsenic	13	1700
		Lead	400	160000
		Benzo(a)anthracene	0.9	69
		Benzo(a)pyrene	0.09	75
		Benzo(b)fluoranthene	0.9	94
		Benzo(k)fluoranthene	9.0	39
		Dibenzo(a,h)anthracene	0.09	9.6
		Indeno(1,2,3-cd)pyrene	0.9	39
K17	0-6”	Arsenic	13	23
		Lead	400	2000
K19	0-6”	Lead	400	460
		Benzo(a)anthracene	0.9	1.6
		Benzo(a)pyrene	0.09	2.2
		Benzo(b)fluoranthene	0.9	2.6
		Dibenzo(a,h)anthracene	0.09	0.58
		Indeno(1,2,3-cd)pyrene	0.9	1.4
M3	0-6”	Benzo(a)pyrene	0.09	0.15
M11	6-12”	Lead	400	620
M13	0-6”	Antimony	31	1700
		Arsenic	13	760
		Lead	400	180000
M13	6-12”	Antimony	31	32
		Arsenic	13	47
		Lead	400	1300
M15	0-6”	Antimony	31	6700
		Arsenic	13	2400

Sample Location	Sample Interval	Contaminant of Concern	Residential Ingestion SROs (mg/kg)	Sample Result (mg/kg)
		Lead	400	170000
M15	6-12”	Antimony	31	36
		Lead	400	400
M19	0-6”	Lead	400	450
M21	0-6”	Benzo(a)pyrene	0.09	0.15
O11	0-6”	Lead	400	430
O13	0-6”	Arsenic	13	31
		Lead	400	5100
O15	0-6”	Antimony	31	88
		Arsenic	13	69
		Lead	400	5900
O15	6-12”	Lead	400	670
O17	0-6”	Arsenic	13	30
		Lead	400	4600
O19	0-6”	Antimony	31	47
		Arsenic	13	28
		Lead	400	4600
		Benzo(a)pyrene	0.09	0.13
O19	6-12”	Lead	400	1000
Q11	0-6”	Lead	400	640
Q15	0-6”	Arsenic	13	20
		Lead	400	2100
Q19	0-6”	Lead	400	530
Q21	0-6”	Benzo(a)pyrene	0.09	0.26
S15	0-6”	Lead	400	920
B-4/MW-7	0-3’	Benzo(a)pyrene	0.09	0.22
B-5/MW-8	0-3’	Arsenic	13	44
		Lead	400	5600
SS-1	0-3”	Lead	400	1300
SS-3	0-3”	Lead	400	1300
		Arsenic	13	14
SS-5	0-3”	Lead	400	2700
		Arsenic	13	21
SS-7	0-3”	Lead	400	3600
		Arsenic	13	22
H14	0-6”	Lead	400	1500
K9	0-6”	Lead	400	1500
M11	0-6”	Lead	400	1900
	6-12”	Lead	400	1600
N20	0-6”	Lead	400	730
O13	6-12”	Lead	400	590
Q13	0-6”	Lead	400	2700
Q17	0-6”	Lead	400	1500
M13	0-6”	Lead	400	120000
M17	0-6”	Lead	400	8200
H18	0-6”	Benzo(a)anthracene	0.9	98
		Benzo(a)pyrene	0.09	110

Sample Location	Sample Interval	Contaminant of Concern	Residential Ingestion SROs (mg/kg)	Sample Result (mg/kg)
		Benzo(b)fluoranthene	0.9	120
		Benzo(k)fluoranthene	9.0	50
		Chrysene	88	180
		Dibenzo(a,h)anthracene	0.09	21
		Indeno(1,2,3-cd)pyrene	0.9	40
E18(N15',E15')	0-6"	Benzo(a)anthracene	0.9	280
		Benzo(a)pyrene	0.09	350
		Benzo(b)fluoranthene	0.9	350
		Benzo(k)fluoranthene	9.0	160
		Chrysene	88	390
		Dibenzo(a,h)anthracene	0.09	69
		Indeno(1,2,3-cd)pyrene	0.9	130
D16(N15',E5')	0-6"	Benzo(a)anthracene	0.9	480
		Benzo(a)pyrene	0.09	640
		Benzo(b)fluoranthene	0.9	750
		Benzo(k)fluoranthene	9.0	230
		Chrysene	88	570
		Dibenzo(a,h)anthracene	0.09	150
		Indeno(1,2,3-cd)pyrene	0.9	330
G17	0-6"	Benzo(a)anthracene	0.9	160
		Benzo(a)pyrene	0.09	150
		Benzo(b)fluoranthene	0.9	100
		Benzo(k)fluoranthene	9.0	35
		Chrysene	88	350
		Dibenzo(a,h)anthracene	0.09	44
		Indeno(1,2,3-cd)pyrene	0.9	26
D14(N15',W10')	0-6"	Benzo(a)anthracene	0.9	110
		Benzo(a)pyrene	0.09	90
		Benzo(b)fluoranthene	0.9	68
		Benzo(k)fluoranthene	9.0	63
		Chrysene	88	250
		Dibenzo(a,h)anthracene	0.09	18
		Indeno(1,2,3-cd)pyrene	0.9	11
E13	0-6"	Benzo(a)pyrene	0.09	0.12
I13	0-6"	Benzo(a)pyrene	0.09	0.13
G13	0-6"	Benzo(a)pyrene	0.09	0.47

In summary, former shooting range related activities have impacted the Site with the metals (Lead, Arsenic and Antimony). Impacts have been delineated and generally are confined to the expected shot-fall zone(s) and within the upper 1.5 feet of the soil horizon. Within the former small arms range berm area isolated metals soil impacts have also been identified.

It is noted that the extent of metals in soil impacts extend beyond the existing eastern facility fence line. This identified condition, is consistent with the shot-fall projections resultant from the former trap-shooting station location (formerly located ~100 feet east of existing stations). As an interim safety measure, the NPD has installed a temporary security fence line to control potential un-authorized access to the impacted soil zones. This interim measure was documented in a July 27, 2012 correspondence to the SRP.

PNA impacts have also been delineated and generally occur within the anticipated down-range target brake zones (both east and west of the central channel areas) and proximal to the existing trap houses where inadvertent target breakage occurred. No PNA impacts have been identified outside of the existing facility fence lines.

A further evaluation of the Soil Ingestion Exposure Route exceedance for Lead, Arsenic, Antimony, and applicable PNAs will be addressed within a subsequent *Remedial Objectives Report (ROR)* and *Remedial Action Plan (RAP).*

5.1.2 Construction Worker Soil Ingestion

Results of this investigation identified that the Soil Remediation Objectives for the Construction Worker Ingestion Exposure Pathways have been exceeded and are summarize in **Table 5.1.2** below:

Table 5.1.2
Summary of Construction Worker Soil Ingestion Exposure Pathway Exceedances

Sample Location	Sample Interval	Contaminant of Concern	Residential Ingestion SROs (mg/kg)	Sample Result (mg/kg)
A5 (E25, S35)	0-6”	Lead	700	780
E15	0-6”	Benzo(a)pyrene	17	93
		Dibenzo(a,h)anthracene	17	29
F5 (E35, S12)	0-6”	Lead	700	910
G13	0-6”	Lead	700	3000
I11	0-6”	Lead	700	5600
I11	6-12”	Lead	700	90000
I13	0-6”	Antimony	82	3100
		Arsenic	61	1200
		Lead	700	110000
I15	0-6”	Antimony	82	610
		Arsenic	61	280
		Benzo(a)pyrene	17	130
		Dibenzo(a,h)anthracene	17	22
		Lead	700	94000
K15	0-6”	Antimony	82	7100
		Arsenic	61	1700
		Benzo(a)pyrene	17	75
		Lead	700	160000
K17	0-6”	Lead	700	2000
M13	0-6”	Antimony	82	1700
		Arsenic	61	760
		Lead	700	180000
M13	6-12”	Lead	700	1300
M15	0-6”	Antimony	82	6700
		Arsenic	61	2400
		Lead	700	170000
O13	0-6”	Lead	700	5100
O15	0-6”	Antimony	82	88
		Arsenic	61	69
		Lead	700	5900

Sample Location	Sample Interval	Contaminant of Concern	Residential Ingestion SROs (mg/kg)	Sample Result (mg/kg)
O17	0-6”	Lead	700	4600
O19	0-6”	Lead	700	4600
	6-12”	Lead	700	1000
Q15	0-6”	Lead	700	2100
S15	0-6”	Lead	700	920
B-5/MW-8	0-3’	Lead	700	5600
SS-1	0-3”	Lead	700	1300
SS-3	0-3”	Lead	700	1300
SS-5	0-3”	Lead	700	2700
SS-7	0-3”	Lead	700	3600
H14	0-6”	Lead	700	1500
K9	0-6”	Lead	700	1500
M11	0-6”	Lead	700	1900
N20	0-6”	Lead	700	730
Q13	0-6”	Lead	700	2700
Q17	0-6”	Lead	700	1500
M13	0-6”	Lead	700	120000
M17	0-6”	Lead	700	8200
M11	6-12”	Lead	700	1600
E18(N15,E15’)	0-6”	Benzo(a)anthracene	170	280
		Benzo(a)pyrene	17	350
		Benzo(b)fluoranthene	170	350
		Dibenzo(a,h)anthracene	17	69
H18	0-6”	Benzo(a)pyrene	17	110
		Dibenzo(a,h)anthracene	17	21
D16(N15,E5’)	0-6”	Benzo(a)anthracene	170	480
		Benzo(a)pyrene	17	640
		Benzo(b)fluoranthene	170	750
		Dibenzo(a,h)anthracene	17	150
		Indeno(1,2,3-cd)pyrene	170	330
G17	0-6”	Benzo(a)pyrene	17	150
		Dibenzo(a,h)anthracene	17	44
D14(N15’,W10’)	0-6”	Benzo(a)pyrene	17	90
		Dibenzo(a,h)anthracene	17	18

A further evaluation of the Construction Worker Soil Ingestion Exposure Route exceedance will be addressed within a subsequent *ROR/RAP.*

5.2 Soil Inhalation Exposure Pathway

Shaw has evaluated the Soil Inhalation Exposure Pathway for both residential receptors and construction worker populations. Evaluation of this pathway was accomplished by directly comparing the chemical analytical results for all soil samples obtained to the Tier 1 Soil Remediation Objectives for the Residential and Construction Worker Inhalation Exposure Pathways as listed in *TACO*.

5.2.1 Residential Soil Inhalation

Results of this investigation identified that the Soil Remediation Objectives for the Residential Inhalation Exposure Pathways are achieved and excluded from further consideration at all sampling locations with the following exceptions listed in **Table 5.2.1** below:

Table 5.2.1
Summary of Residential Soil Inhalation Exposure Pathway Exceedances

Sample Location	Sample Interval	Contaminant of Concern	Residential Ingestion SROs (mg/kg)	Sample Result (mg/kg)
I13	0-6”	Arsenic	750	1200
K15	0-6”	Arsenic	750	1700
M13	0-6”	Arsenic	750	760
M15	0-6”	Arsenic	750	2400

A further evaluation of the Residential Soil Inhalation Exposure Route exceedance for Arsenic will be addressed within a subsequent *ROR/RAP.*

5.2.2 Construction Worker Soil Inhalation

Results of this investigation identified that the Soil Remediation Objectives for the Construction Worker Inhalation Exposure Pathways are achieved and excluded from further consideration at all sampling locations with the following exceptions listed in **Table 5.2.2** below:

Table 5.2.2
Summary of Construction Worker Soil Inhalation Exposure Pathway Exceedances

Sample Location	Sample Interval	Contaminant of Concern	Residential Ingestion SROs (mg/kg)	Sample Result (mg/kg)
I15	0-6”	Naphthalene	1.8	2.4
H6	0-6”	Mercury	0.1	0.11
H18	0-6”	Naphthalene	1.8	<3.9
E18(N15’,E15’)	0-6”	Naphthalene	1.8	<4.0
G17	0-6”	Naphthalene	1.8	<3.6
D14(N15’,W10’)	0-6”	Naphthalene	1.8	<3.6

A further evaluation of the Construction Worker Soil Inhalation Exposure Route exceedance for Naphthalene and Mercury will be addressed within a subsequent *ROR/RAP.*

5.3 Toxicity Characteristic Soil Impacts

Results of this investigation identified that the RCRA TC threshold relative to Lead (5.0 mg/L) has been exceeded. Soils exhibiting toxicity characteristics are generally confined to the upper 0.5 to 1.0 feet of the on-Site soils and are located throughout the central and eastern portions of the Site within the expected shot-fall zone(s), and within limited/isolated areas along the former small arms shooting berm/back-stop.

Figure 13 through **Figure 15** depicts the estimated extent of Lead soil impacts that exceed the RCRA TC limit for Lead. Soil samples detected above the RCRA Lead TC threshold value are

summarized in **Table 5.3** below:

Table 5.3
Summary of Soil Toxicity Characteristic Exceedances

Sample Location	Sample Interval	TCLP Contaminant of Concern	Total Concentration (mg/kg)	TCLP Concentration (mg/kg)
A5 (E25, S35)	0-6”	Lead	780	9.6
F5 (E35, S12)	0-6”	Lead	910	49
G7	0-6”	Lead	66	7.6
I11	0-6”	Lead	5600	12
	6-12”	Lead	90000	24
I13	0-6”	Lead	110000	310
	12-18”	Lead	580	5.5
I15	0-6”	Lead	94000	15
K15	0-6”	Lead	160000	110
K17	0-6”	Lead	2000	14
M11	0-6”	Lead	1900	56
	6-12”	Lead	1600	21
M13	0-6”	Lead	180000	530
	6-12”	Lead	1300	350
M15	0-6”	Lead	170000	500
M17	0-6”	Lead	8200	88
O13	0-6”	Lead	5100	8.7
O15	0-6”	Lead	5900	53
O17	0-6”	Lead	4600	9.3
O19	0-6”	Lead	4600	11
SS-5	0-3”	Lead	2700	9.8
SS-7	0-3”	Lead	3600	41
H14	0-6”	Lead	1500	20
Q13	0-6”	Lead	2700	5.9
Q17	0-6”	Lead	1500	8.3
I7	0-6”	Lead	220	6.1
F5(E30’,S15’)	6-12”	Lead	230	53

In accordance with the requirements of *TACO,* soils exhibiting RCRCA characteristics of toxicity cannot be directly excluded from further consideration. A further evaluation of the Lead soil toxicity conditions will be addressed within a subsequent *ROR/RAP.*

5.4 Sediment Exposure Pathway

Shaw performed an initial screening evaluation for the Sediment Exposure Pathway. Evaluation of this pathway was accomplished by directly comparing the chemical analytical results for all sediment samples obtained to the USEPA Sediment Quality Guidelines (USEPA SQGs), the IEPA Draft baseline SRCs, and the RCRA TC threshold limits, were applicable. The USEPA SQGs have been developed for various Metals and PNAs. The draft IEPA SRCs have only been developed for limited Volatile Organic Compounds (VOCs) and PNA compounds.

The IEPA Draft SRCs have been designed to be protective of sensitive receptors at a site, human or non-human, by using conservative assumptions about exposure potential and

represent the National Oceanic and Atmospheric Administration (NOAA) Effects Range Low (ER-L) or the consensus-based Threshold Effect Concentration (TEC) or PEC values.

TEC is generally defined as "below which harmful effects are unlikely to be observed". PEC is generally defined as "above which harmful effects are likely to be observed". The USEPA SQGs represent both consensus-based TEC and PEC values.

5.4.1 USEPA Sediment Quality Guidelines and RCRA Toxicity Thresholds

Results of this investigation identified that the USEPA SQGs relative to the consensus-based PECs and/or RCRA-TC thresholds are achieved and excluded from further consideration with the following exceptions listed in **Table 5.4.1** below:

Table 5.4.1
Summary of USEPA Sediment Quality Guideline Concentrations Exceedances

Sample Location	Sample Interval	Contaminant of Concern	USEPA Sediment Quality Guideline Concentration (mg/kg)	Sample Result (mg/kg)	TCLP Concentration (mg/L)
G19	0-6"	Benzo[a]anthracene	1.05	3.1	---
		Benzo[a]pyrene	1.45	4.7	---
		Chrysene	1.29	3.9	---
		Fluoranthene	2.23	3.9	---
		Phenanthrene	1.17	1.2	---
		Pyrene	1.52	3.9	---
		Total PAHs	22.8	36.29	---
		Lead	128	190	0.66
		Copper	149	1600	---
		Zinc	459	810	---
I9	0-6"	Arsenic	33	39	0.066
		Lead	128	5400	**9.0**
J13	0-6"	Arsenic	33	92	---
		Chromium	111	510	---
		Copper	149	580	---
		Lead	128	6400	**34**
	6-12"	Arsenic	33	310	0.067
		Lead	128	120,000	**120**
J15	0-6"	Lead	128	3000	**8.4**
	6-12"	Lead	128	2900	**23**
K7	0-6"	Copper	149	320	---
		Lead	128	1900	2.7
K10(W25')	0-6"	Lead	128	150000	**9.3**
		Arsenic	33	2200	0.11
	6-12"	Lead	128	950	**43**
J17(N30,W20')	0-6"	Lead	128	2600	0.12
	6-12"	Lead	128	110000	3.0
		Arsenic	33	1900	0.047
	12-18"	Lead	128	890	0.66
K12 (W25')	0-6"	Lead	128	4200	0.85
	6-12"	Lead	128	4600	**73**
	12-18"	Lead	128	530	**8.6**

***Bolded** value exceeds TCLP RCRA Toxicity Limit for Lead of 5.0 mg/L*

In accordance with the requirements of *TACO,* any Site impact exhibiting RCRA characteristics of toxicity cannot be directly excluded from consideration. A further evaluation of the sediment toxicity conditions and impacts exceeding the USEPA SQGs will be addressed within a subsequent *ROR/RAP.*

5.4.2 IEPA Baseline Sediment Remediation Concentration (SRC)

Results of this investigation identified that the IEPA Draft Tier 1 Baseline SRCs are achieved and can be excluded from further consideration at all sampling locations with the following exceptions listed in **Table 5.4.2** below:

Table 5.4.2
Summary of IEPA Draft Tier 1
Baseline Sediment Remediation Concentration (SRC) Exceedances

Sample Location	Sample Interval	Contaminant of Concern	IEPA Baseline Sediment Remediation Concentration (SRC) (mg/kg)	Sample Result (mg/kg)
G19	0-6”	Anthracene	0.057	0.29
		Benzo[a]anthracene	0.11	3.1
		Benzo[a]pyrene	0.057	4.7
		Benzo[b]fluoranthene	0.75	6.0
		Chrysene	0.17	3.9
		Dibenz(a,h)anthracene	0.033	0.66
		Fluoranthene	2.8	3.9
		Fluorene	0.035	0.13
		Indeno[1,2,3-cd]pyrene	0.31	2.5
		Phenanthrene	0.81	1.2
		Pyrene	0.2	3.9
		Total PAHs	1.6	36.29
J13	0-6”	Benzo[a]pyrene	0.057	0.12
	6-12”	Benzo[a]anthracene	0.11	0.33
		Benzo[a]pyrene	0.057	0.46
		Chrysene	0.17	0.49
		Dibenz(a,h)anthracene	0.033	0.072
		Fluorene	2.8	0.038
		Pyrene	0.2	0.57
		Total PAHs	1.6	4.454
J15	0-6”	Benzo[a]anthracene	0.11	0.65
		Benzo[a]pyrene	0.057	1.1
		Benzo[b]fluoranthene	0.75	1.3
		Chrysene	0.17	0.77
		Dibenz(a,h)anthracene	0.033	0.16
		Indeno[1,2,3-cd]pyrene	0.31	0.50
		Pyrene	0.2	0.82
		Total PAHs	1.6	7.587
	6-12”	Benzo[a]anthracene	0.11	0.39
		Benzo[a]pyrene	0.057	0.62
		Chrysene	0.17	0.48
		Dibenz(a,h)anthracene	0.033	0.11
		Indeno[1,2,3-cd]pyrene	0.31	0.40

Sample Location	Sample Interval	Contaminant of Concern	IEPA Baseline Sediment Remediation Concentration (SRC) (mg/kg)	Sample Result (mg/kg)
		Pyrene	0.2	0.48
		Total PAHs	1.6	4.824
K10(W25')	0-6"	Benzo[a]pyrene	0.057	0.13
		Total PAHs	1.6	1.706
H10 (N30')	0-6"	Benzo[a]anthracene	0.11	0.20
		Benzo[a]pyrene	0.057	0.34
		Chrysene	0.17	0.24
		Total PAHs	1.6	3.65
J17(N30',W20')	0-6"	Benzo[a]anthracene	0.11	0.46
		Benzo[a]pyrene	0.057	0.65
		Benzo[b]fluoranthene	0.75	0.82
		Chrysene	0.17	0.63
		Indeno[1,2,3-cd]pyrene	0.31	0.50
		Pyrene	0.2	0.62
		Total PAHs	1.6	7.89
	6-12"	Benzo[a]anthracene	0.11	0.71
		Benzo[a]pyrene	0.057	0.93
		Benzo[b]fluoranthene	0.75	1.2
		Chrysene	0.17	0.90
		Dibenzo(a,h)anthracene	0.033	0.30
		Indeno[1,2,3-cd]pyrene	0.31	0.64
		Pyrene	0.2	0.85
		Total PAHs	1.6	8.87
	12-18"	Benzo[a]anthracene	0.11	0.16
		Benzo[a]pyrene	0.057	0.20
		Chrysene	0.17	0.17
		Dibenzo(a,h)anthracene	0.033	0.063
		Total PAHs	1.6	1.929
K12 (W25')	6-12"	Benzo[a]pyrene	0.057	0.079
	12-18"	Total PAHs	1.6	3.428

A further evaluation of the sediment impacts exceeding the IEPA Draft Tier 1 Baseline SRCs will be addressed within a subsequent *ROR/RAP.*

5.5 Soil Component of the Groundwater Ingestion Exposure Pathway

Shaw evaluated the Soil Component of the Migration to Groundwater Exposure Pathway. Evaluation of this pathway was accomplished by directly comparing the chemical analytical results for all soil samples obtained to the Tier 1 pH Specific Soil Remediation Objectives and TCLP Specific Objectives for the Soil Component of the Migration to Class I Groundwater Exposure Pathway as listed in *TACO*.

Results of this investigation identified that the Soil Remediation Objectives for the Soil Component of the Groundwater Ingestion Exposure Pathways have been exceeded and are summarized in **Table 5.5** and **Table 5.5.1** below:

Table 5.5
Summary of Soil Component of the Groundwater Ingestion Exposure Pathway Exceedances

Sample Location	Sample Interval	Contaminant of Concern	pH Value (Total Metals)	Soil Component of Class I Groundwater Ingestion Objectives (mg/kg)	Sample Result (mg/kg)
A5 (E25, S35)	0-6”	Lead	6.75	107 [7]	780
C5.5	0-6”	Lead	7.04	107 [7]	170
	12-18”	Lead	7.38	107 [7]	430
C17	0-6”	Lead	6.21	23 [6]	86
	6-12”	Lead	6.20	23 [6]	24
D6	0-6”	Lead	7.39	107 [7]	140
	6-12”	Lead	8.55	107 [7]	120
E15	0-6”	Antimony	4.52	5 [1]	5.9
		Benzo(a)anthracene	---	2.0	150
		Benzo(a)pyrene	---	8.0	93
		Benzo(b)fluoranthene	---	5.0	51
		Chrysene	---	160	280
		Dibenzo(a,h)anthracene	---	2.0	29
		Indeno(1,2,3-cd)pyrene	---	14	19
		Lead	4.52	23 [6]	240
	6-12”	Lead	6.50	107 [7]	110
F5 (E35, S12)	0-6”	Lead	6.82	107 [7]	910
G5.5	0-6”	Lead	7.80	107 [7]	160
	6-12”	Lead	8.03	107 [7]	200
G7	0-6”	Lead	5.68	23 [6]	66
G13	0-6”	Antimony	5.06	5 [1]	23
		Lead	5.06	23 [6]	3000
	12-18”	Lead	6.21	23 [6]	34
G15	6-12”	Lead	4.59	23 [6]	160
	12-18”	Lead	5.26	23 [6]	47
G17	0-6”	Lead	4.92	23 [6]	27
H6	0-6”	Lead	6.72	107 [7]	130
I7	0-6”	Lead	7.60	107 [7]	220
I11	0-6”	Antimony	7.19	5 [1]	67
		Arsenic	7.19	29 [3]	56
		Lead	7.19	107 [7]	5600
	6-12”	Lead	7.70	107 [7]	90000
I13	0-6”	Antimony	6.42	5 [1]	3100
		Arsenic	6.42	29 [3]	1200
		Lead	6.42	107 [7]	110000
	12-18”	Antimony	7.10	5 [1]	18
		Lead	7.10	107 [7]	580
I15	0-6”	Antimony	7.35	5 [1]	610
		Arsenic	7.35	30 [4]	280
		Benzo(a)anthracene	---	2.0	110
		Benzo(a)pyrene	---	8.0	130
		Benzo(b)fluoranthene	---	5.0	140

Sample Location	Sample Interval	Contaminant of Concern	pH Value (Total Metals)	Soil Component of Class I Groundwater Ingestion Objectives (mg/kg)	Sample Result (mg/kg)
		Benzo(k)fluoranthene	---	49	78
		Dibenzo(a,h)anthracene	---	2.0	22
		Indeno(1,2,3-cd)pyrene	---	14	64
		Lead	7.35	107 [7]	94000
I17	0-6”	Antimony	6.43	5 [1]	8.7
		Lead	6.43	107 [7]	500
I19	0-6”	Lead	7.42	107 [7]	150
K15	0-6”	Antimony	7.12	5 [1]	7100
		Arsenic	7.12	29 [3]	1700
		Benzo(a)anthracene	---	2.0	69
		Benzo(a)pyrene	---	8.0	75
		Benzo(b)fluoranthene	---	5.0	94
		Chromium	7.12	36 [5]	49
		Dibenzo(a,h)anthracene	---	2.0	9.6
		Indeno(1,2,3-cd)pyrene	---	14	39
		Lead	7.12	107 [7]	160000
	6-12”	Lead	6.34	107 [7]	290
	12-18”	Lead	6.10	23 [6]	26
K17	0-6”	Antimony	6.69	5 [1]	14
		Lead	6.69	107 [7]	2000
K19	0-6”	Lead	6.57	107 [7]	460
	6-12”	Lead	5.66	23 [6]	71
	12-18”	Lead	5.52	23 [6]	26
M9	0-6”	Antimony	8.27	5 [1]	5.5
		Lead	8.27	107 [7]	120
M11	6-12”	Antimony	6.44	5 [1]	5.2
		Lead	6.44	107 [7]	620
M13	0-6”	Antimony	7.17	5 [1]	1700
		Arsenic	7.17	29 [3]	760
		Lead	7.17	107 [7]	180000
	6-12”	Antimony	5.87	5 [1]	32
		Arsenic	5.87	28 [2]	47
		Lead	5.87	23 [6]	1300
M15	0-6”	Antimony	6.45	5 [1]	6700
		Arsenic	6.45	29 [3]	2400
		Lead	6.45	107 [7]	170000
	6-12”	Antimony	5.63	5 [1]	36
		Lead	5.63	23 [6]	400
M19	0-6”	Antimony	5.67	5 [1]	13
		Lead	5.67	23 [6]	450
M21	0-6”	Lead	7.00	107 [7]	120
O11	0-6”	Lead	6.66	107 [7]	430
O13	0-6”	Antimony	6.12	5 [1]	17
		Arsenic	6.12	28 [2]	31
		Lead	6.12	23 [6]	5100
O15	0-6”	Antimony	7.68	5 [1]	88
		Arsenic	7.68	30 [4]	69

Sample Location	Sample Interval	Contaminant of Concern	pH Value (Total Metals)	Soil Component of Class I Groundwater Ingestion Objectives (mg/kg)	Sample Result (mg/kg)
		Lead	7.68	107 [7]	5900
	6-12”	Lead	6.79	107 [7]	670
	12-18”	Lead	6.52	107 [7]	140
O17	0-6”	Antimony	6.09	5 [1]	24
		Arsenic	6.09	28 [2]	30
		Lead	6.09	23 [6]	4600
O19	0-6”	Antimony	6.51	5 [1]	47
		Lead	6.51	107 [7]	4600
	6-12”	Lead	6.06	23 [6]	1000
	12-18”	Lead	5.46	23 [6]	79
Q3	0-6”	Lead	6.21	23 [6]	29
Q7	0-6”	Lead	6.23	23 [6]	39
Q11	0-6”	Lead	6.18	23 [6]	640
Q15	0-6”	Antimony	5.85	5 [1]	8.0
		Lead	5.85	23 [6]	2100
Q19	0-6”	Lead	6.36	107 [7]	530
S15	0-6”	Lead	6.85	107 [7]	920
	6-12”	Lead	5.85	23 [6]	98
	12-18”	Lead	5.56	23 [6]	24
B-5/MW-8	0-3’	Antimony	7.47	5 [1]	15
		Arsenic	7.47	30 [4]	44
		Lead	7.47	107 [7]	5600
SS-1	0-3”	Lead	5.92	23 [6]	1300
SS-3	0-3”	Lead	6.83	107 [7]	1300
SS-5	0-3”	Lead	6.74	107 [7]	2700
		Antimony		5 [1]	7.7
SS-7	0-3”	Lead	7.02	107 [7]	3600
		Antimony		5 [1]	8.6
SS-9	0-3”	Lead	6.85	107 [7]	360
H18	0-6”	Benzo(a)anthracene	---	2.0	98
		Benzo(a)pyrene	---	8.0	110
		Benzo(b)fluoranthene	---	5.0	120
		Benzo(k)fluoranthene	---	49	50
		Chrysene	---	160	180
		Dibenzo(a,h)anthracene	---	2.0	21
		Indeno(1,2,3-cd)pyrene	---	14	40
E18 (N15’,E15’)	0-6”	Benzo(a)anthracene	---	2.0	280
		Benzo(a)pyrene	---	8.0	350
		Benzo(b)fluoranthene	---	5.0	350
		Benzo(k)fluoranthene	---	49	160
		Chrysene	---	160	390
		Dibenzo(a,h)anthracene	---	2.0	69
		Indeno(1,2,3-cd)pyrene	---	14	130
D16 (N15’,E5’)	0-6”	Benzo(a)anthracene	---	2.0	480
		Benzo(a)pyrene	---	8.0	640
		Benzo(b)fluoranthene	---	5.0	750
		Benzo(k)fluoranthene	---	49	230

Sample Location	Sample Interval	Contaminant of Concern	pH Value (Total Metals)	Soil Component of Class I Groundwater Ingestion Objectives (mg/kg)	Sample Result (mg/kg)
		Chrysene	---	160	570
		Dibenzo(a,h)anthracene	---	2.0	150
		Indeno(1,2,3-cd)pyrene	---	14	330
G17	0-6”	Benzo(a)anthracene	---	2.0	160
		Benzo(a)pyrene	---	8.0	150
		Benzo(b)fluoranthene	---	5.0	100
		Chrysene	---	160	350
		Dibenzo(a,h)anthracene	---	2.0	44
		Indeno(1,2,3-cd)pyrene	---	14	26
D14 (N15’,W10’)	0-6”	Benzo(a)anthracene	---	2.0	110
		Benzo(a)pyrene	---	8.0	90
		Benzo(b)fluoranthene	---	5.0	68
		Benzo(k)fluoranthene	---	49	63
		Chrysene	---	160	250
		Dibenzo(a,h)anthracene	---	2.0	18

NOTES:

[1] Antimony pH Specific SRO 4.5 to 9.0 = 5 mg/kg
[2] Arsenic pH Specific SRO 5.75 to 6.24 = 28 mg/kg
[3] Arsenic pH Specific SRO 6.25 to 7.24 = 29 mg/kg
[4] Arsenic pH Specific SRO 7.25 to 7.74 = 30 mg/kg
[5] Chromium pH Specific SRO 6.9 to 7.24 = 36 mg/kg
[6] Lead pH Specific SRO 4.5 to 6.24 = 23 mg/kg
[7] Lead pH Specific SRO 6.25 to 8.74 = 107 mg/kg

Table 5.5.1
Summary of Soil Component of the Groundwater Ingestion Exposure Pathway TCLP Exceedances

Sample Location	Sample Interval	Contaminant of Concern	Soil Component of Class I Groundwater Ingestion SROs (mg/L)	Toxicity Characteristic Threshold (mg/l)	TCLP Result (mg/L)
A5 (E25, S35)	0-6”	Lead	0.0075	5	**9.6**
A6 (E25’,N15’)	6-12”	Lead	0.0075	5	0.066
A7	0-6”	Lead	0.0075	5	0.011
C5.5	0-6”	Lead	0.0075	5	0.31
	6-12”	Lead	0.0075	5	0.23
	12-18”	Lead	0.0075	5	0.57
C7	0-6”	Lead	0.0075	5	0.013
E15	0-6”	Lead	0.0075	5	1.3
F5 (E35, S12)	0-6”	Lead	0.0075	5	**49**
F5 (E30,S15’)	6-12”	Lead	0.0075	5	**53**
F6	0-6”	Lead	0.0075	5	0.01
	6-12”	Lead	0.0075	5	<0.0075
	12-18”	Lead	0.0075	5	<0.0075
G7	0-6”	Arsenic	0.05	5	0.055
		Lead	0.0075	5	**7.6**
G11	0-6”	Lead	0.0075	5	0.87
	12-18”	Lead	0.0075	5	<0.0075
G13	0-6”	Lead	0.0075	5	0.0091
	12-18”	Lead	0.0075	5	0.31

Sample Location	Sample Interval	Contaminant of Concern	Soil Component of Class I Groundwater Ingestion SROs (mg/L)	Toxicity Characteristic Threshold (mg/l)	TCLP Result (mg/L)
G15	6-12”	Lead	0.0075	5	1.3
	12-18”	Lead	0.0075	5	0.031
G17	0-6”	Lead	0.0075	5	1.5
H6	0-6”	Lead	0.0075	5	0.034
	6-12”	Lead	0.0075	5	<0.0075
H14	0-6”	Lead	0.0075	5	**20**
	6-12”	Lead	0.0075	5	<0.0075
I7	0-6”	Lead	0.0075	5	**6.1**
	6-12”	Lead	0.0075	5	<0.0075
	12-18”	Lead	0.0075	5	0.012
I11	0-6”	Arsenic	0.05	5	0.16
		Lead	0.0075	5	**12**
	6-12”	Arsenic	0.05	5	0.25
		Lead	0.0075	5	**24**
I13	0-6”	Arsenic	0.05	5	0.34
		Lead	0.0075	5	**310**
		Cadmium	0.005	1	0.0071
	12-18”	Arsenic	0.05	5	0.15
		Lead	0.0075	5	**5.5**
	18-24”	Lead	0.0075	5	0.007
I15	0-6”	Arsenic	0.05	5	0.34
		Lead	0.0075	5	**15**
	6-12”	Lead	0.0075	5	0.069
I17	0-6”	Arsenic	0.05	5	0.091
		Lead	0.0075	5	3.2
I19	0-6”	Lead	0.0075	5	0.53
J20	0-6”	Lead	0.0075	5	0.013
K9	0-6”	Lead	0.0075	5	0.95
K15	0-6”	Arsenic	0.05	5	0.39
		Lead	0.0075	5	**110**
	6-12”	Lead	0.0075	5	0.17
	12-18”	Lead	0.0075	5	0.056
K17	0-6”	Arsenic	0.05	5	0.30
		Lead	0.0075	5	**14**
	6-12”	Lead	0.0075	5	0.051
K19	0-6”	Lead	0.0075	5	1.0
	6-12”	Lead	0.0075	5	0.011
M9	0-6”	Lead	0.0075	5	0.28
M11	0-6”	Lead	0.0075	5	**56**
	6-12”	Lead	0.0075	5	**21**
M13	0-6”	Arsenic	0.05	5	1.8
		Lead	0.0075	5	**530**
		Cadmium	0.005	1	0.0062
	6-12”	Lead	0.0075	5	0.82
	12-18”	Lead	0.0075	5	1.3
M15	0-6”	Arsenic	0.05	5	3.0
		Lead	0.0075	5	**500**

Sample Location	Sample Interval	Contaminant of Concern	Soil Component of Class I Groundwater Ingestion SROs (mg/L)	Toxicity Characteristic Threshold (mg/l)	TCLP Result (mg/L)
	6-12”	Arsenic	0.05	5	0.13
		Lead	0.0075	5	2.0
M17	0-6”	Lead	0.0075	5	**88**
M19	0-6”	Lead	0.0075	5	0.27
N20	0-6”	Lead	0.0075	5	0.26
	6-12”	Lead	0.0075	5	0.0069
O11	0-6”	Lead	0.0075	5	1.6
	6-12”	Lead	0.0075	5	0.025
O13	0-6”	Arsenic	0.05	5	0.15
		Lead	0.0075	5	**8.7**
	6-12”	Lead	0.0075	5	0.23
O15	0-6”	Lead	0.0075	5	**53**
	6-12”	Lead	0.0075	5	0.078
O17	0-6”	Arsenic	0.05	5	0.34
		Lead	0.0075	5	**9.3**
	6-12”	Lead	0.0075	5	0.24
O19	0-6”	Arsenic	0.05	5	0.42
		Lead	0.0075	5	**11**
	6-12”	Arsenic	0.05	5	0.18
		Lead	0.0075	5	**34**
	12-18”	Lead	0.0075	5	0.31
Q11	0-6”	Lead	0.0075	5	0.13
Q13	0-6”	Lead	0.0075	5	**5.9**
	6-12”	Lead	0.0075	5	0.048
Q15	0-6”	Lead	0.0075	5	4.6
Q17	0-6”	Lead	0.0075	5	**8.3**
	6-12”	Lead	0.0075	5	0.031
Q19	0-6”	Lead	0.0075	5	0.48
Q21	0-6”	Lead	0.0075	5	0.028
S15	0-6”	Arsenic	0.05	5	0.17
		Lead	0.0075	5	2.1
SS-1	0-3”	Lead	0.0075	5	1.9
SS-3	0-3”	Lead	0.0075	5	0.73
SS-5	0-3”	Lead	0.0075	5	**9.8**
SS-7	0-3”	Lead	0.0075	5	**41**
SS-9	0-3”	Lead	0.0075	5	0.048

Bolded *value exceeds TCLP RCRA Toxicity Limit for Lead of 5.0 mg/L.*

A further evaluation of the Soil Component of the Groundwater Ingestion Exposure Route exceedance for Lead, Arsenic, Antimony, Chromium and PNAs will be addressed within a subsequent *ROR/RAP.*

5.6 Groundwater Ingestion Exposure Pathway

Results of this investigation identified that the Groundwater Remediation Objectives (GROs) for the Class I Groundwater Ingestion Exposure Pathways are achieved and excluded from further consideration at all sampling locations with the following exception(s) listed in **Table 5.6** below:

Table 5.6
Summary of Class I Groundwater Ingestion Exposure Pathway Exceedances

Monitoring Well ID	Contaminant of Concern	Class I Groundwater Ingestion GROs (mg/L)	Sample Result (mg/L)
MW-8	Benzo[a]anthracene	0.00013	0.00014

A further evaluation of the Class I Groundwater Ingestion Exposure Route exceedance for Benzo(a)anthracene will be provided in a subsequent ROR/RAP.

5.7 Groundwater Receptors

Shaw performed a groundwater receptor survey through review and assessment of potable water well location information and reconnaissance activities. Shaw reviewed information received from the IEPA (Division of Public Water Supplies), Illinois Department of Public Health, and the DuPage County Health Department, and conducted well searches through the IEPA *Source Water Assessment Protection Program (SWAPP)*, Illinois State Geological Survey (ISGS) database, and the Illinois State Water Survey (ISWS) database to determine the location of potable water supply wells located within a radius of 2,500 feet of the Site. **Appendix L** contains the potable water well survey information.

The Site clubhouse contains is serviced by the private water wells designated for non-potable use. The well is reported to be 110 feet deep and draws water from crevices in the dolomite bedrock.

The west adjoining residential subdivision, including the adjoining residences on Green Acres Drive, receive water from individual private potable water wells. The information within the database search was not suitable to correlate well construction logs to the individual residences.

The well database review identified nine (9) potable wells within a radius of 1,000 feet of the Site. The database and literature review identified fifteen (15) potable wells and three (3) engineer test wells are located within a radius of 2,500 feet of the Site. The well information is summarized in **Table 5.7** below:

Table 5.7
Summary of Wells Located within 2,500 feet of the Site

API Number	Well ID	Owner	Well Type	Direction	Approx. Distance	Source
---	---	*Naperville Park District*	Non-Potable	On-Site	---	Phase I ESA 2011
120433089900	30899	*Moser Builders*	Water	W	568	SWAPP/ISWS
120433186100	31861	*Mckeown Classic Homes*	Water	W	605	ISGS/ISWS
120433178700	31787	*Mckeown Classic Homes*	Water	W	614	ISGS/ISWS
120433051700	30517	*Mary & Richard Patap*	Water	W	650	SWAPP/ISWS
120432986200	29862	*Bradley Bennett*	Water	W	650	SWAPP/ISGS

API Number	Well ID	Owner	Well Type	Direction	Approx. Distance	Source
120433080800	30808	*Dan Rubino*	Water	W	650	SWAPP/ISWS
120433182700	31827	*Mckeown Classic Homes/Morris*	Water	N	759	ISGS/ISWS
120433182800	31828	*Thomas Walega*	Water	SW	845	ISGS/ISWS
120430011200	00112	*Lipscomb*	Water	SW	1,018	SWAPP/ISGS
120433173600	31736	*Mckeown Classic Homes*	Water	SW	1,172	ISGS/ISWS
120432525200	25252	*Virginia Ehrart*	Water	W	1,210	SWAPP/ISGS
120433081300	30813	*Dale Fredrickson*	Water	W	1,340	SWAPP/ISWS
120433146400	31464	*Leslie Phillips #1*	Water	W	1,340	SWAPP/ISWS
120432975200	29752	*Thomas Kuhn*	Water	SW	1,343	SWAPP/ISGS
120432812900	28129	*Helen Wittry*	Water	SW	1,360	SWAPP/ISGS
120433146300	31463	*City of Naperville*	Water	S	1,362	SWAPP
120433196900	31969	*Grant Bell #1*	Water	W	1,385	ISGS/ISWS
120430026500	00265	*Bender Wm*	Water	W	1,607	SWAPP/ISGS
120430213400	02134	*John Vertuno*	Water	NW	1,660	ISGS
120433196100	31961	*Mckeown Classic Homes*	Water	S	1,748	ISGS/ISWS
120430115000	01150	*O'Connell Bldg & Dev*	Water	W	1,940	SWAPP/ISGS
120430051300	00513	*Harry Jones*	Water	NW	2,297	SWAPP/ISGS
120433028400	30284	*Edward Hospital Addn.*	Engineering	NE	2,345	ISGS
120433028500	30285	*Edward Hospital Addn.*	Engineering	NE	2,345	ISGS
120433028600	30286	*Edward Hospital Addn.*	Engineering	NE	2,345	ISGS
120430160700	01607	*E J Hariss*	Water	SW	2,361	SWAPP/ISGS
120432863500	28635	*Naperville Park District*	Water	N	2,413	SWAPP/ISGS

The nearest well is identified in the *SWAPP* database as Well I.D. # 30899, which is located approximately 568 feet to the west of the Site. According to the ISWS records the well was installed to a depth of 200 feet on 02/14/2002. No information was available regarding the setback zone of the well, or aquifer that the well draws from.

Eight (8) ISGS water wells were identified within 1,000 feet of the Site. The ISGS wells are identified in the *SWAPP/ISGS* databases for Well IDs: 31861, 31787, 30517, 29862, 30808, 31827, 31828, and 00112. These wells range between approximately 600 and 1,000 feet from the Site.

Fifteen (15) ISGS water wells and three (3) engineering test well (ENG) wells were identified between 1,000 feet and within 2,500 feet of the Site. The ISGS wells are identified in the *SWAPP/ISGS* databases for Well IDs: 31736, 25252, 30813, 31464, 29752, 28129, 31463, 31969, 00265, 02134, 31961, 01150, 00513, 01607, and 28635. These wells range in depth from approximately 71 to 1485 feet.

The ENG wells are identified in the *SWAPP/ISGS* databases for Well IDs: 30284-30286. These wells range in depth from approximately 36 to 41 feet. The ISGS database does not specify whether these engineering test wells still exist.

No Class III groundwater, Non-Community/Community Water Wells, Phase II Wellhead Protection Areas, Non-CWS Phase I Wellhead Protections Areas, Groundwater Ordinances, or Minimum Set-Back Zones were identified within 2,500 feet of the Site.

5.8 Surface Water Receptors

Shaw evaluated the surface water receptor pathway due to the proximity of on-Site surface water features (North Pond, Equalization Channel and South Pond) and associated wetlands. The historical trap-shooting activities and down-range shot-fall zones were located within portions of the surface water features and wetland areas.

With the exception of the Total Lead concentration detected in water sample SW-1, the surface water samples did not exceed Water Quality Standards. This evaluation is consistent with the historical NPDES monitoring. Monitoring of the surface water receptor will continue subject to the provisions of the existing NPDES discharge permit.

5.9 Other Migration Pathways

Shaw evaluated other potential migration pathways including natural and man-made migration pathways (i.e. subsurface utility lines at and/or near the Site). Based on the available information and Site observations, Shaw has not identified any other potential/preferential migration pathways at the Site.

6.0 CONCLUSIONS

Based on information obtained during the Shaw focused investigations, including the results of field observations and analysis of numerous soil, sediment, groundwater and surface water samples, Shaw has developed the following conclusions:

Based on information obtained during the Shaw 2012 focused investigations, including the results of field observations and analysis of numerous soil, sediment, groundwater and surface water samples, Shaw has developed the following conclusions:

1) The investigation consisted of making a total of 7 soil borings throughout the investigation area. The borings were continuously sampled to depths ranging between 12 and 16 feet below ground surface (bgs). With few exceptions, the sample recoveries were typically good, and the subsurface stratigraphy encountered was generally consistent at each of the boring locations. The subsurface stratigraphy predominantly consisted of of fine grained materials (clays and silts) with intermingled sands and gravels. Gray silty clay was encountered at approximately 16 feet bgs to the terminus of the borings. Based on measurements obtained from 9 monitoring wells installed at the Site and one off site monitoring well, groundwater levels within the investigation area ranged from approximately 1.51 to 20.25 feet bgs. Multiple measurements made during this investigation indicated that groundwater flow direction varies. The minimum and maximum measured gradient is 0.001 to 0.007 ft/ft, respectively. The results of in-situ permeability tests performed in the monitoring wells indicated that the average hydraulic conductivity of the water bearing unit is 4.55×10^{-5} cm/sec.

   In order to characterize the shot fall deposition zone and berms, the investigation also included: 130 hand auger borings to a depth of 18 inches bgs, 12 surface water samples, and 20 core samples advanced into sediments.

2) A total of 303 soil samples were systematically obtained from throughout the investigation area for laboratory and/or XRF analysis. Two hundred and one soil samples were submitted to an environmental laboratory for chemical analysis of the focused contaminants of concern: Total Metals (Lead, Arsenic, Barium, Cadmium, Chromium, Mercury, Selenium, Silver, Antimony, Copper, and Zinc), and PNAs. Select soil samples were also tested for pH, Fractional Organic Carbon (FOC) and Toxicity Characteristic Leaching Procedure (TCLP) Metals.

   Consistent with previous investigation conducted at the Site (as summarized in IEPA June 1997 Project Summary), results of the chemical analyses identified various contaminants of concern in several of the soil samples at concentrations that exceed their most stringent *Tiered Approach to Corrective Action Objectives* (*TACO*) Tier 1 Soil Remedial Objectives (SROs). Contaminants of concern include: Lead, Arsenic, Antimony and select PNA compounds. Furthermore, 27 samples exceeded the RCRA Toxicity Characteristic (TC) threshold concentration of 5.0 mg/L for Lead.

3) A total of 9 groundwater samples were obtained from 9 monitoring wells installed at the Site. The groundwater samples were submitted to an environmental laboratory for chemical analysis of Total Metals (Lead, Arsenic, Barium, Cadmium, Chromium, Mercury, Selenium, Silver, Antimony, Copper, and Zinc), and PNAs. Benzo(a)anthracene exceeded the *TACO* Tier 1 Groundwater Remedial Objective (GRO) for the Class I Groundwater Ingestion Exposure Pathway at 1 monitoring well location.

4) A total of 48 sediment samples were obtained at the Site. The sediment samples were submitted to an environmental laboratory for chemical analysis of Total Metals (Lead, Arsenic, Barium, Cadmium, Chromium, Mercury, Selenium, Silver, Antimony, Copper, and Zinc), and PNAs. Select soil samples were also tested for pH, Fractional Organic Carbon (FOC) and Toxicity Characteristic Leaching Procedure (TCLP) Metals. Select PNAs and Inorganic Metals exceeded the IEPA and US EPA guidance criteria. Additionally, 9 samples exceeded the RCRA Toxicity Characteristic (TC) threshold concentration of 5.0 mg/L for Lead.

5) A total of 12 surface water samples were obtained at the Site over 2 separate sampling events. Six (6) initial surface water samples were submitted to an environmental laboratory for chemical analysis of one or more of the following Total Metals (Lead, Arsenic, Barium, Cadmium, Chromium, Mercury, Selenium, Silver, Antimony, Copper, and Zinc), and PNAs. Based upon the initial water sample results, 1 sample detected Total Lead. Six (6) additional water samples were subsequently collected and tested for Dissolved Lead and Total Hardness, for direct evaluation of the Lead water quality standard. None of the supplemental water samples exceeded the surface water quality standard for Dissolved Lead.

6) Shaw recommends that a *Remedial Objectives Report/Remedial Action Plan* be developed and submitted to the Illinois Environmental Protection Agency Site Remediation Program for review and approval.


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